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THESE EXPERIMENTS, IT IS TRUE, ARE NOT EASY; STILL THEY ARE IN THE POWER OF EVERY THINKING HUSBANDMAN. HE WHO ACCOMPLISHES BUT ONE, OF HOWEVER LIMITED APPLICATION, AND TAKES CARE TO REPORT IT FAITHFULLY, ADVANCES THE SCIENCE, AND, CONSEQUENTLY, THE PRACTICE OF AGRICULTURE, AND ACQUIRES THEREBY A RIGHT TO THE GRATITUDE OF HIS FELLOWS, AND OF THOSE WHO COME AFTER. TO MAKE MANY SUCH IS BEYOND THE POWER OF MOST INDIVIDUALS, AND CANNOT BE EXPECTED. THE FIRST CARE OF ALL SOCIETIES FORMED FOR THE IMPROVEMENT OF OUR SCIENCE SHOULD BE TO PREPARE THE FORMS OF SUCH EXPERIMENTS, AND TO DISTRIBUTE THE EXECUTION OF THESE AMONG THEIR MEMBERS.

VAN THAER, *Principles of Agriculture.*

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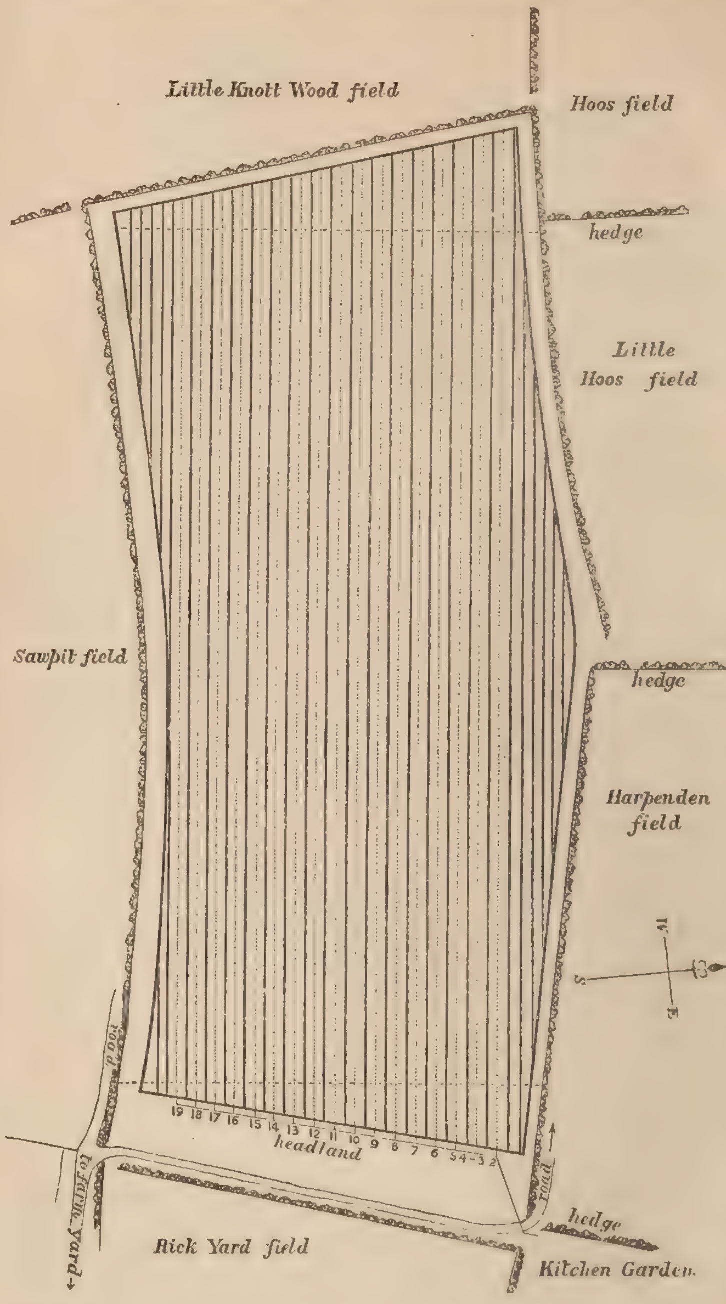
The Binder is desired to collect together all the Appendix matter, with Roman numeral folios, and place it at the *end* of each volume of the Journal, excepting Titles and Contents, and Statistics &c., which are in all cases to be placed at the *beginning* of the Volume; the lettering at the back to include a statement of the *year* as well as the *volume*; the first volume belonging to 1839–40, the second to 1841, the third to 1842, the fourth to 1843, and so on.

In Reports of the Journal all Appendix matter and, in one instance, an Article in the body of the Journal (which at the time had become obsolete), were omitted; the Roman numeral folios, however (for convenience of reference), were reprinted without alteration in the Appendix matter retained.

ERRATUM.

On p. 589, vol. xvii., lines 34–5, *for* "the prize-pens of Mr. Read, Mr. Lambert, and Mr. Parsons, put respectively first, second, and third," *read* "the prize-pens of Mr. Read, Mr. Parsons, and Messrs. J. A. and F. Palmer." On line 37, *for* "Mr. Parson's pen," *read* "Messrs. Palmer's pen."

Plan of Broadbalk Field, showing the system of Drain-pipes.



JOURNAL

OF THE

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

I.—*On the Amount and Composition of the Rain and Drainage-Waters collected at Rothamsted.* Part III. By J. B. Lawes, LL.D., F.R.S., F.C.S.; J. H. Gilbert, Ph.D., F.R.S., F.C.S.; and R. Warington, F.C.S.

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Part III.—The Drainage Waters from Land Cropped and Manured.

In the first paper on the Rothamsted Field Experiments, published in this 'Journal' in 1847, it was shown that a considerable part of the nitrogen applied as manure was not recovered in the increase of the crop produced.* Later determinations of the quantity of nitrogen remaining in the soil after a long course of manuring showed that only a comparatively small proportion of the missing nitrogen could be accounted for by accumulations within the soil.† The conviction gradually increased that the

* See also the following more recent Rothamsted Reports in this 'Journal'—"On the Growth of Barley by different Manures, continuously on the same Land; and on the position of the crop in rotation," 1857, pp. 524, 528-531; and "Report of Experiments on the Growth of Barley for 20 years in succession on the same Land," 1873, pp. 328–331. Also, "On the Annual Yield of Nitrogen per acre in Different Crops;" 'Report of British Association,' 1858.

† See the Paper "On the accumulation of the Nitrogen of Manure in the Soil;" 'Report of British Association,' 1866.

loss of nitrogen thus observed might be to a great extent due to the washing out of nitrates from the soil during heavy rain.* An excellent opportunity of testing the soundness of this conclusion was afforded by the experiments in Broadbalk Field, this field having been for many years cropped with wheat, manured with various kinds of manure, and being furnished with a complete system of drain-pipes. The investigation of the drainage-waters from this field commenced in 1866. Before speaking of the results we must briefly describe the conditions of the experiment.

1. The Experimental Field.

Broadbalk Field contains about $13\frac{1}{2}$ acres of arable land, of which only $11\frac{3}{4}$ acres are now under exact experiment. The field lies in "lands," each $4\frac{1}{8}$ yards wide; two adjoining lands form the two halves, *a* and *b*, of one plot. Both on the extreme right and left of the field there are, however, a few plots consisting of one land only. The length of the principal plots (Nos. 2–19) is 352 yards; the area of each "land" is thus $\frac{3}{10}$ acre.

The field was laid with drain-pipes in 1849, but without, at that time, any intention of employing them for experimental purposes. A drain was laid down the centre of each plot, from Plot 2 to Plot 18, the course of the drain lying under the furrow, separating the two lands of which each plot consists. A drain was also laid along the outer edge of Plot 19, which consisted at that time of one land only. The drains were thus $8\frac{1}{4}$ yards apart.

A plan of Broadbalk Field will be found opposite the first page. The thick parallel lines represent the side-boundaries of the plots, the lines across the field show the end-boundaries; no manure has been applied for many years above or below these lines. The dotted parallel lines show the system of drain-pipes. The number of the plot to which each drain belongs is shown at the lower end of the plan.

The general slope of Broadbalk Field is from west to east. The total fall of the drain of Plot 19 amounts to 12 feet $1\frac{1}{2}$ inches; on the other side of the field, in the middle of Plot 2, the fall is 16 feet 9 inches in 352 yards. The inclination is but small in the upper part of the field, it occurs chiefly in the lower five-eighths of its length. The drains deliver entirely at the lower end of the field. At this end there is a small fall of 1 foot $9\frac{3}{4}$ inches from Plot 19 to Plot 2.

The drain-pipes employed were those known as the "horseshoe and sole;" the internal diameter of the drain is about 2 inches.

* See the Second Report on the Growth of Barley, already mentioned, pp. 331–345; also "Our Climate and our Wheat Crops;" this 'Journal,' 1880, p. 199.

The drains lie generally about 2 feet below the furrow under which they are placed; the depth is greatest towards the middle of the field, where it reaches about $2\frac{1}{2}$ feet. The lower ends of the drains were originally connected with a main drain, 4 inches in diameter, lying across the headland at the bottom of the field; by this main drain the water was conveyed to a ditch at a considerably lower level.

Early in December 1866 the connection of the drain-pipes from Plots 2–16 with the main drain was severed, and small pits dug at the previous points of junction. The drain-water flowing from the pipes was now discharged into the pits, and samples could be collected from the pipes before the water was carried off by the main drain. The ends of the pipes from Plots 17–19 were not uncovered till November 1878.

The arrangements just described for collecting the drainage-waters were at first by no means perfect. During heavy rains a considerable amount of surface-water collected in the intermediate furrows* at the bottom of the field, chiefly towards the left-hand side; this was in extreme cases reinforced by a flood coming through the hedge from Saw-pit Field. To remove this surface-water a furrow was opened across the bottom of the field, starting at the hedge-green by Saw-pit Field, crossing the lower edge of Plots 19 and 18, and coming out on to the headland at the bottom of the field at the furrow separating Plots 2 and 1. After some time, the point of exit of this surface-drain was altered to the furrow separating Plots 3 and 2, it being thought that the drainage from Plot 2, which is always very scanty, was affected by the water thus brought over its drain-pipe. In the autumn of 1877 a surface-drain was constructed along the hedge by Saw-pit Field; and in the following autumn a large soak-pit was dug in Saw-pit Field; both with the object of protecting Broadbalk from flood-water. This object is now fairly accomplished. Surface-floods occur at present only from the melting of snow, or in storms of very exceptional character.

Another difficulty at first experienced was due to the small outfall provided by the drains. In heavy rains the pits into which the drains delivered quickly filled above the level of the pipes, and it was necessary to bale out the water in each pit before a collection from the pipe was possible. The water filling any pit being to some extent a mixture of the drainage-waters of all the plots lying to the left of it (the same main drain passing through all the pits), there was some danger of

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* In heavy rain surface-water runs down the alternate furrows in considerable quantity, it rarely appears in the furrow occupying the centre of each plot, owing to the action of the drain-pipe beneath.

the drainage-waters being contaminated by the waters from other plots, and it was necessary, after baling the water out of each pit, to allow the pipe to run for some time before a trustworthy sample of water could be collected.

These arrangements are now much improved. The surface-drain running across the bottom of the field has been abolished; the alternate furrows, forming the boundaries of each plot, have been prolonged on to the headland, and connected by a 4-inch pipe with the main drain, thus removing the surface-water between each plot without passing it over the drain-pipes of other plots. The main drain has also been considerably enlarged, and relaid 1 foot below its former level. In consequence of this improvement the outfall-pits now never fill with water, and no difficulty is experienced in collecting at all times the drainage-water flowing from the pipes. These improvements were completed in February 1879.

It has been necessary to go into this detail because the value of the analyses of the drainage-waters entirely depends on these waters truly representing the drainage of particular plots of soil. It will be gathered from what has just been stated, that the earlier collections of waters were somewhat more liable to occasional contamination, both from surface-water, and from mixture with the waters of adjoining plots, than the collections made since February 1879.

Since the opening of the drains, a careful record has been kept of the dates on which each drain ran, and of the size of the flow when observed. In the driest season experienced (October 1873 to September 1874) the largest number of runnings recorded for any pipe was three; while in the wettest season (1878–9), the largest number of runnings from one pipe was forty-six. In Table XXXVI. is given the total number of daily runnings of each drain-pipe during fifteen years.

In summer time, while the field is covered by the crop, drainage rarely takes place. A commencement of running is usually made in October, and the drainage reaches its greatest vigour in December and January.

It will be noticed that the drains from the various plots do not run with equal frequency. Plots with a similar winter drainage show a dissimilar summer drainage if one bears a heavier crop; the relative amount of drainage from two plots is even in some cases reversed at different seasons of the year, the plot having the greater winter drainage giving a less summer drainage by reason of its larger produce. Such facts will be seen by comparing the records of drainage for Plot 3&4 with those for Plot 7; those for Plot 5 with Plot 6; and Plot 11 with Plot 13. The average crops grown on all these plots will be

TABLE XXXVI.—NUMBER of DAYS that each DRAIN-PIPE ran in BROADBALK FIELD during 15 YEARS, 1867–81.

	Plots.														Mean per Plot.
	2.	3&4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	
January	19	39	49	48	47	44	41	38	44	50	45	33	30	27	40
February	8	27	30	34	27	27	27	26	30	29	30	20	18	19	25
March	2	13	12	13	10	9	9	9	10	11	11	4	6	6	9
April	2	12	14	12	11	10	9	10	10	11	11	9	6	7	10
May	1	6	7	6	5	4	6	4	6	5	4	3	4	4	5
June	3	10	11	12	6	3	4	5	9	7	7	3	3	2	6
July	1	8	9	8	5	5	5	6	8	7	6	5	4	5	6
August	1	6	6	6	6	5	5	6	6	6	6	3	4	6	5
September	2	7	8	6	4	4	4	7	7	5	4	3	3	3	5
October	8	21	20	22	16	14	15	17	22	18	17	10	11	12	16
November	12	35	39	40	31	30	27	25	34	35	37	23	27	25	30
December	13	43	51	58	50	47	38	46	53	51	52	32	26	24	42
April—September	10	49	55	50	37	31	33	38	46	41	38	26	24	27	36
October—March	62	178	201	215	181	171	157	161	193	194	192	122	118	113	161
Total 15 years	72	227	256	265	218	202	190	199	239	235	230	148	142	140	197
Mean per year ..	5	15	17	18	15	13	13	13	16	16	15	10	9	9	13

be found in Table XXXVII (p. 8). In all these cases the greater evaporation by the heavier crops dries the soil, and thus diminishes the drainage.

There are considerable differences in the rate of running of the pipes of some of the plots which are quite independent of any difference in the crop; such differences are best seen by looking at the total runnings recorded for the winter months, October to March, as no irregularity is then introduced from differences in the bulk of the crop.

It will be seen that the drain-pipe from Plot 2 runs with far less frequency than any other; the running is only for a short time, and the water is always turbid. This plot has received 14 tons of farmyard-manure each year since 1844. A great accumulation of organic matter has thus taken place, which has greatly increased the power of the soil to hold water. In a paper on the "Effects of the Drought in 1870 on some of the Experimental Crops at Rothamsted," published in this 'Journal' in 1871, determinations are given of the water contained in the soil of three of the plots in Broadbalk, both in a dry summer (July 1868), and when in a state of winter saturation (January 1869). In the latter condition the three soils contained the following amounts of water, expressed in tons per acre, to the depth of 3 feet from the surface.

	Plot 2. Farmyard Manure.	Plot 3. Unmanured.	Plot 8. Ammonium-Salts and Mineral Manure.
	Tons.	Tons.	Tons.
Water in saturated soil ..	1610	1396	1549

The soil of Plot 2 thus contained, when saturated, 214 tons more water than the soil of Plot 3, and 61 tons more than the soil of Plot 8; quantities corresponding to 2·12 and 0·60 inches of rain respectively. The small amount of pipe-drainage from this plot is thus to some extent explained. The drain-pipe of Plot 2 has been opened to ascertain if any obstruction existed, but none was found. In consequence of the rare discharge of drainage-water from Plot 2, a series of glass bottles has been connected with the end of the drain-pipe; a discharge occurring at any time is thus preserved.

It is difficult to account for the very different rates of running of some of the pipes. The drains from Plots 2 to 13 must have a fall of about 16 feet in the length of the plot; from Plot 14 to 19 the fall diminishes to about 12 feet. All the plots running most frequently lie in the former group. Most frequent

or longest running does not, however, always imply the largest discharge. A study of the records that have been regularly made of the size of the streams issuing from the different pipes would show that the largest discharge is from Plots 13, 17, 3&4. Next in order stand Plots 11, 18, 12, 6, 5, which appear to be very equal. The third group is formed of Plots 15, 16, 14. The fourth group consists of Plots 10, 7. The fifth of Plots 9, 8. Last of all come Plots 2, 19. The amount of water passing off by the drain-pipes in the case of the fifth group is perhaps two-thirds of that discharged by the first group of plots; this will probably represent the extreme range of variation, if we except Plots 2 and 19. The cause of some of these differences apparently admits of explanation; thus a part of the water from Plots 8, 9, 10, 14, is probably intercepted by dells, through or alongside which the drain-pipes pass. The character of the subsoil is also an important factor. Where the subsoil is exceptionally stony, as is the case in certain places in the field, the water conveyed by the drain may be more or less lost, this loss of water being greatly facilitated by the character of the drain-pipes used.

The account just given of the mode of running of the drains in Broadbalk Field will seem strange in many particulars to those who are familiar with the working of deep drains on heavy clay land; the drains on such land will usually run uninterruptedly throughout the winter, while the drains in Broadbalk Field continue running only a few hours after rain has ceased. The cause of difference lies in the fact that the Broadbalk drains are comparatively near the surface, and that any accumulation of subsoil water is prevented by the chalk which underlies the soil at a depth of about 10 to 14 feet from the surface. The drainage-waters from Broadbalk are thus a discharge of the water percolating through the soil, while the drainage from the deep drains in heavy land is mainly supplied from a reservoir of subsoil water.

We have now to describe the manures applied to the various plots in Broadbalk Field. The manures applied, and the average produce obtained during the last fifteen seasons, 1866–7 to 1880–81, through more or less of which the investigation of the drainage-waters has continued, and during the 30 seasons (1852–81) of nearly uniform manuring year after year, will be found in Table XXXVII. In the case of Plots 2 and 3 the manuring has remained unaltered since 1844, the date of the first experimental wheat-crop.

The dressing of "mixed mineral manure" contains in every case 3½ cwts. of bone-ash superphosphate, 200 lbs. of commercial sulphate of potassium, 100 lbs. of sulphate of sodium (nitre-cake), and 100 lbs. of crystallised sulphate of magnesium per

TABLE XXXVII.—MANURING and PRODUCE of BROADBALK WHEAT-FIELD, per ACRE, per ANNUM.

PLOT.	MANURES.	30 Years, 1852–1881.		15 Years, 1867–1881.	
		Dressed Corn.	Total Produce (Corn and Straw).	Dressed Corn.	Total Produce (Corn and Straw).
		Bushels.	lbs.	Bushels.	lbs.
2	14 tons Farmyard-Manure	$33\frac{1}{2}$	4696	$31\frac{1}{2}$	5304
3&4	Unmanured	$13\frac{1}{2}$	2169	$11\frac{1}{4}$	1726
5	Mixed Mineral Manure	$15\frac{1}{2}$	2443	$12\frac{3}{4}$	1984
6	200 lbs. Ammonium-salts and Mixed Minerals	24	4006	$20\frac{1}{4}$	3348
7	400 lbs. " " ..	$32\frac{1}{2}$	5769	$28\frac{1}{8}$	5013
8	600 lbs. " " ..	36	6737	$33\frac{1}{3}$	6219
9*a*	550 lbs. Nitrate of Sodium and "	$36\frac{1}{5}$	6903	$36\frac{1}{4}$	6920
9*b*	550 lbs. Nitrate of Sodium, alone	$23\frac{1}{2}$	4293	$20\frac{1}{4}$	3587
10	400 lbs. Ammonium-salts, alone	$21\frac{7}{8}$	3687	18	2904
11	" " " and Superphosphate	26	4402	$22\frac{1}{4}$	3716
12	" " " and Sulph. Sodium	31	5301	$26\frac{1}{2}$	4493
13	" " " and Sulph. Potassium	$31\frac{1}{2}$	5561	$28\frac{3}{8}$	4964
14	" " " and Sulph. Mag.	$31\frac{3}{8}$	5424	$27\frac{7}{8}$	4716
15	" " " and Mixed Minerals[1]	$31\frac{1}{8}$	5396	$28\frac{1}{2}$	4826
16	Unmanured[2]	$25\frac{1}{2}$	4678	$13\frac{3}{8}$	2131
17	Mixed Mineral Manure[3]	[4] $15\frac{3}{4}$	2574	[4] $13\frac{1}{4}$	2090
18	400 Ammonium-salts[3]	[5] $29\frac{3}{4}$	5171	[5] 27	4619
19	1700 lbs. of Rape-cake[6]	$28\frac{1}{2}$	4758	$25\frac{1}{4}$	4025

[1] For 1872 and previously, 400 lbs. sulphate of ammonium were applied on half the plot, and on the other half 300 lbs. sulphate of ammonium and 500 lbs. of rape-cake, both halves receiving mixed mineral manure. Up to 1872 the superphosphate for this plot was prepared with hydrochloric acid.

[2] From 1852 to 1864 this plot received 800 lbs. ammonium-salts, with the mixed mineral manure.

[3] The manures on these two plots alternate each year.

[4] Average of mineral manure, alternating with ammonium-salts.

[5] Average of ammonium-salts, alternating with mineral manure.

[6] For 1878 and previously, 300 lbs. sulphate of ammonium, 500 lbs. rape-cake, with superphosphate, the latter made with hydrochloric acid.

acre.* The same quantity of superphosphate ($3\frac{1}{2}$ cwts.) is applied in all cases; but an increased amount of the sulphates of sodium and magnesium is applied to Plots 12 and 14, the quantities of the two sulphates being respectively $366\frac{1}{2}$ and 280 lbs.

The "ammonium-salts" are in every case a mixture of equal parts of the sulphate and muriate of commerce. The 400 lbs. of ammonium-salts, the 550 lbs. of nitrate of sodium, and the 1700 lbs. of rape-cake are believed to contain approximately the same quantity of nitrogen; the rape-cake is somewhat variable in composition.

In Table XXXVIII. will be found an estimate of the quantity of each substance annually applied in manure, expressed

* In 1858, and previously, 300 lbs. of sulphate of potassium, and 200 lbs. of sulphate of sodium were employed.

TABLE XXXVIII.—QUANTITIES of each CONSTITUENT of MANURE annually applied to BROADBALK FIELD, from 1858–9 (and in some cases earlier) to 1880–1, in lbs. per ACRE.

	Plots.																		
	2.	3&4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.		16.	17 and 18.		19.	
													1859–72.	1873–81.		Ammonium-Salts.	Mineral Manure.	1859–78.	1879–81.
Potash ..	235	..	100	100	100	100	50	..	..	..	100	..	103	100	..	..	100	..	21
Soda	31	..	41	41	41	41	212	..	1	147	1	1	41	41	..	..	41	1	3
Lime	31	..	86	86	86	86	43	..	86	86	86	86	88	86	..	..	86	86	12
Magnesia ..	35	..	18	18	18	18	9	..	2	2	2	47	20	18	..	..	18	2	12
Phos. Acid	78	..	64	64	64	64	32	..	64	64	64	64	69	64	..	..	64	64	33
Sulph. Acid	47	..	265	321	376	432	132	111	208	397	292	298	363	376	..	111	265	167	5
Chlorine ..	38	..	..	60	119	179	7	119	119	119	119	119	68	119	..	119	..	68	..
Nitrogen ..	201	..	..	43	86	129	86	86	86	86	86	86	80	86	..	86	..	83	81

in lbs. per acre. The estimated composition of the farmyard-manure applied on Plot 2 must be taken as approximate only. The small quantities of magnesia and soda credited to Plots 11–13 are contained in the bone-ash used.

All the manures, except the dung, are sown broad-cast; during sowing two screens are carried along the boundaries of the plots to prevent the manure being carried beyond its proper limits. The autumn manures are ploughed or harrowed in as soon as possible after sowing, the wheat being drilled afterwards. The spring manures are top-dressed.

The farmyard-manure, the superphosphate, and the sulphates of potassium, sodium, and magnesium, have always been applied in the autumn. During the first six seasons in which the drainage-waters were collected the ammonium-salts were applied on all the plots in the autumn, and had been uniformly so applied for many years previously. Since 1872–3 the ammonium-salts have been applied on Plot 15 at a different time from the other plots. In the five seasons, 1872–3 to 1876–7, Plot 15 received its ammonia in the spring, the other plots in the autumn. Since this time the order has been reversed, Plot 15 receiving ammonium-salts in the autumn, and all the remaining plots in the spring. The nitrate of sodium has always been applied in the spring.

As the dates of sowing manure and of harvest are points which must be borne in mind in discussing the composition of the drainage-waters, a summary of these particulars is given in Table XXXIX.

TABLE XXXIX.—DATES OF SOWING MANURES and of HARVEST in BROADBALK FIELD, 1866–7 to 1880–1.

Season.	Manures Applied.				Wheat Cut.
	Mineral Manures.	Ammonium-salts.		Nitrate of Sodium.	
		Plot 15.	Other Plots.		
1866–7	Nov. 5–6.	Nov. 5–6.		Mar. 25.	Aug. 23–24.
1867–8	Oct. 30–Nov. 1.	Oct. 30–Nov. 1.		,, 18.	July 22–28.
1868–9	,, 28–31.	Oct. 28–31.		Apr. 1.	Aug. 16–18.
1869–70	,, 30–Nov. 2.	Oct. 30–Nov. 2.		Mar. 25.	,, 5–12.
1870–1	,, 18–22.	Oct. 18–22.		,, 23.	,, 21–23.
1871–2	,, 16–17.	Oct. 16–17.		,, 7.	,, 16–17.
1872–3	,, 17–18.	Mar. 25.	Oct. 17–18.	,, 25.	,, 15–19.
1873–4	,, 27–28.	,, 19.	,, 27–28.	,, 19.	,, 3–11.
1874–5	,, 20–23.	,, 23.	,, 20–23.	,, 23.	,, 16–21.
1875–6	,, 29–30.	,, 24.	,, 29–30.	,, 24.	,, 8–19.
1876–7	,, 16–17.	Apr. 11.	,, 16–17.	Apr. 11.	,, 18–24.
1877–8	Nov. 2–3.	Nov. 2–3.	Mar. 14.	Mar. 14.	,, 1–10.
1878–9	Oct. 14–15.	Oct. 14–15.	,, 10–13.	,, 10.	Sept. 4–17.
1879–80	,, 22.	,, 22.	,, 9.	,, 9.	Aug. 14–20.
1880–81	,, 15–16.	,, 25.	,, 12.	,, 12.	,, 8–11.
1881–2	,, 27–28.	,, 27–28.	Feb. 23.	Feb. 23.	..

2. The Composition of the Drainage-Waters.

The first investigation upon the composition of the drainage-waters from Broadbalk Field was conducted by Dr. Voelcker. He examined in all five series of drain-waters, each collected when the drains were flowing largely, and including samples from nearly all the pipes. The collections were made on Dec. 6, 1866; on May 21, 1867; on Jan. 13, 1868; on April 21, 1868: and on Dec. 29, 1868. The results of the 65 analyses are given in detail in a paper "On the Composition of Waters of Land-Drainage.," communicated by Dr. Voelcker to this 'Journal' in 1874, page 132.*

In Table XL. we have recalculated into parts per million † the principal ingredients found in two of the most characteristic series of waters, and have also given the mean composition of the drainage from each plot, calculated from the whole of Dr. Voelcker's analyses.‡ The collection on Jan. 13, 1868, was the first considerable running after the application of the autumn manures; the collection on April 21 was a later running in the same season, after the application of the nitrate of sodium to Plot 9. From want of space, the determinations of organic matter (by ignition), oxide of iron, carbonic acid, and silica are omitted.

Dr. Voelcker's analyses are of special value, as they are the only ones giving a full account of the mineral constituents contained in the waters from the various plots. We shall, however, postpone the consideration of the results until we have the whole subject before us.

The next examination of the Broadbalk waters was made by Dr. Frankland. He made in all 103 analyses, the collections extending from Jan. 13, 1868, to Feb. 26, 1873. Five of these

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* A Summary of the results was communicated by Dr. Voelcker to the Chemical Society in 1871; see Jour. Chem. Soc. xxiv. 276.

† We have given the whole of the analyses of rain and drainage-water in parts per million, partly because any smaller unit involves the use of long decimals, and partly because results thus expressed are equally intelligible to English and foreign readers; "parts per million" are indeed identical with the "milligrams per litre," commonly employed on the Continent. For those English readers to whom a million may appear a vague term we may here state, that 1 inch of water per acre weighs 226,263 lbs., consequently 10 parts per million of nitrogen, lime, or any other constituent in a drainage-water, corresponds to a loss of 2·26 lbs. per acre for each inch of drainage.

‡ The mean composition of the drainage from Plot 2 is calculated from two analyses, that of Plot 15 from three analyses, the other means are calculated from five analyses. The potash and soda were determined only in the last four series of waters. Phosphoric acid was determined in the fourth series of waters, and partly in the second and third; the means given are of two determinations, save in the case of Plots 7, 8, and 9, in which phosphoric acid was only determined in the fourth series.

TABLE XL.—COMPOSITION of DRAINAGE-WATERS from BROADBALK FIELD in parts per MILLION (DR. VOELCKER).

Plots.	Total Solid Matter.	Lime.	Magnesia.	Potash.	Soda.	Nitrogen as: Ammonia.	Nitrogen as: Nitric Acid.	Chlorine.	Sulphuric Acid.	Phosphoric Acid.
					JANUARY 13, 1868.					
2	412·9	136·7	5·1	5·4	13·7	0·05	12·5	21·9	94·6	..
3&4	258·7	102·0	4·6	2·4	5·9	0·15	6·7	14·6	25·0	..
5	405·0	151·6	6·6	10·3	14·9	0·16	9·3	16·7	110·9	..
6	525·0	179·6	9·1	8·6	10·3	0·02	17·0	36·6	119·6	..
7	636·4	235·6	7·7	1·9	15·1	0·07	28·1	28·1	131·6	..
8	720·7	247·3	8·0	3·9	14·4	0·07	31·0	62·6	119·3	..
9	355·0	108·7	3·9	1·7	42·0	0·15	12·0	18·7	56·9	..
10	497·9	208·9	7·7	2·0	7·4	0·08	25·3	45·9	59·3	2·00
11	543·6	201·6	8·0	0·9	9·0	0·07	28·8	51·1	72·6	2·57
12	658·6	234·7	5·9	3·7	34·4	0·05	30·1	57·4	136·3	2·14
13	672·1	246·0	8·3	5·9	8·0	0·11	35·0	58·4	108·4	1·43
14	763·0	270·3	16·1	0·7	8·1	0·06	37·7	60·6	133·4	1·29
15	822·1	274·3	12·7	9·3	18·1	0·21	46·5	36·6	171·6	2·00
16	296·6	112·3	5·9	3·7	4·1	0·09	13·5	17·7	25·4	1·29
					APRIL 21, 1868.					
3&4	202·1	85·1	6·7	1·0	9·6	trace	0·9	8·3	11·3	0·57
5	269·3	95·1	6·6	2·9	11·1	none	1·4	9·3	37·4	1·46
6	325·8	86·3	7·7	3·0	10·7	trace	1·9	10·4	34·7	0·90
7	337·9	114·4	8·0	2·6	7·0	0·08	4·5	16·6	47·6	0·91
8	382·9	102·3	15·1	1·9	4·4	..	6·0	19·7	58·4	0·17
9	683·6	153·6	9·9	6·1	93·9	none	58·3	14·6	23·9	..
10	326·5	111·1	7·4	0·9	5·9	0·09	10·1	17·7	38·7	0·90
11	298·6	117·1	6·6	1·4	4·0	..	7·6	17·7	38·4	0·73
12	384·4	138·3	7·1	2·9	16·9	0·50	1·7	7·3	39·7	0·36
13	396·4	100·3	15·9	1·9	4·3	0·13	5·6	20·9	52·9	0·73
14	423·6	157·3	10·0	1·4	5·3	..	6·7	22·9	66·7	0·73
15	398·6	146·0	6·7	3·1	10·1	..	7·6	12·4	81·0	1·07
16	266·7	102·6	5·6	4·1	8·6	0·06	5·9	14·6	26·4	0·54
					MEAN OF FIVE (OR FEWER) COLLECTIONS.					
2	476·1	147·4	4·9	5·4	13·7	0·16	16·1	20·7	106·1	..
3&4	246·4	98·1	5·1	1·7	6·0	0 12	3·9	10·7	24·7	0·63
5	326·0	124·3	6·4	5·4	11·7	0·13	5·1	11·1	66·3	0·91
6	407·6	143·9	7·9	4·4	10·7	0·20	8·5	20·7	73·3	1·54
7	492·4	181·4	8·3	2·9	10·9	0·07	14·0	26·1	90·1	0·91
8	548·4	197·3	8·9	2·7	10·6	0·27	16·9	39·4	89·7	0·17
9	423·9	118·1	5·9	4·1	56·1	0·24	18·4	12·0	41·0	..
10	406·9	154·1	7·4	1·9	7·1	0·08	13·9	32·0	44·4	1·44
11	425·9	165·6	7·3	1·0	6·6	0·17	15·3	31·6	54·3	1·66
12	530·9	191·6	6·6	2·7	24·6	0·30	15·1	30·9	96·7	1·26
13	544·3	201·4	9·3	3·3	6·1	0·16	17·4	36·6	86·9	1·09
14	598·6	226·7	11·6	1·0	5·6	0·09	19·2	39·4	99·7	1·01
15	585·3	201·1	7·9	5·3	14·3	0·11	24·2	24·6	123·9	1·54
16	286·7	117·1	5·3	2·4	5·1	0·09	7·0	11·4	21·9	0·91

collections, namely those on Jan. 5, May 18, and Oct. 26, 1872; and on Jan. 19 and Feb. 26, 1873, included drainage-waters from nearly all the plots. The collections represented both large and small runnings of the drains. In Table XLI. will be found analyses of the waters collected on Jan. 5 and on May 18, 1872. The first of these collections represents the first general running of the drains since the application of the autumn manures; the pipes were in moderate flow. The second series of waters represents a small flow of the pipes later in the same season, and after the application of nitrate of sodium to Plot 9. The mean composition of the five general collections will also be found in the table.* The whole of the results have been published in detail in the 'Sixth Report of the Rivers' Pollution Commission,' 1874, pp. 58–68.

Since the examination by Dr. Frankland, the composition of the drainage-waters has been further investigated at Rothamsted. The analyses previously made had shown that very considerable quantities of nitric acid were removed in the drainage-waters from the plots receiving ammonium-salts or nitrate of sodium. This loss of nitrogen by drainage appeared to be, from an agricultural point of view, the part of the subject most requiring a fuller investigation; the work done at Rothamsted has therefore been chiefly directed to this part of the question. The examination of the waters has consisted in the determination of the quantity of nitric acid and chlorine present, with qualitative testing for ammonia and nitrous acid. The methods employed were the same as those already mentioned when speaking of the analysis of the waters from the drain-gauges.

By confining the examination of the waters to the determination of the two constituents just named, it has been possible to examine a far larger number of waters than could otherwise have been accomplished. The analyses made include one series of waters collected in 1876, eight series collected in 1877–8, thirty-six series collected in 1878–9, fourteen collected in 1879–80, and forty collected in 1880–1. During the last three seasons, individual or mixed samples, including nearly every running of the drains, have been submitted to analysis. The total number of samples analysed is about 1300. The greater part of these analyses were made by Mr. W. H. A. Peake. We shall be unable to give the results in detail from want of space.

In considering the facts which the investigations of Voelcker,

* The mean composition of the water from Plots 2 and 9, is calculated from four analyses, that of Plot 16 from three analyses. The organic carbon and nitrogen in the water of Plot 10 is the mean of four analyses. The other means represent five analyses.

TABLE XLI.—COMPOSITION of DRAINAGE-WATERS from BROADBALK FIELD in parts per MILLION. (DR. FRANKLAND.)

PLOTS.	Total Solid Matter.	Carbon in Organic Matter.	Nitrogen as: Organic Matter.	Am-monia.	Nitrates and Nitrites.	Total Nitrogen.	Chlorine.	Total Hardness.
				JANUARY 5, 1872.				
2	512·0	4·52	1·41	0·17	25·9	27·5	33·5	321
3&4	344·0	2·17	0·57	0·02	13·1	13·7	14·0	206
5	482·4	1·59	0·60	0·01	14·2	14·8	14·5	357
6	701·6	1·57	0·52	0·01	27·8	28·3	43·0	500
7	862·4	1·94	0·65	0·01	47·4	48·1	68·5	590
8	1239·6	1·80	0·83	0·01	78·4	79·3	112·5	766
9	505·2	1·51	0·60	0·01	23·1	23·7	18·0	335
10	734·4	..	..	0·01	55·6	..	73·5	537
11	931·2	0·90	0·64	0·01	66·8	67·5	92·5	628
12	1016·4	1·09	0·47	0·00	57·7	58·2	80·5	681
13	1056·0	1·24	0·51	0·00	59·2	59·7	91·0	696
14	1059·2	1·63	0·54	0·01	57·8	58·4	95·0	711
15	1162·4	1·27	0·59	0·01	72·5	73·1	57·5	774
16	351·2	12·13	2·77	0·01	13·2	16·0	12·5	248
				MAY 18, 1872.				
3&4	165·0	1·50	0·24	0·00	0·3	0·6	10·5	180
5	238·0	1·35	0·20	0·00	0·7	0·9	7·5	218
6	363·0	2·03	0·29	0·00	0·5	0·8	11·0	297
7	318·0	1·67	0·32	0·00	0·6	0·9	19·5	277
8	381·0	1·97	0·52	0·04	0·9	1·5	16·0	303
9	381·0	1·80	0·53	0·00	16·5	17·0	12·5	242
10	347·0	1·39	0·32	0·00	9·4	9·7	20·0	262
11	396·0	1·28	0·28	0·00	8·3	8·6	23·0	329
12	439·0	1·72	0·31	0·00	4·1	4·4	21·0	400
13	484·0	2·19	0·51	0·00	3·2	3·7	21·0	360
14	478·0	2·47	0·41	0·00	2·3	2·7	21·5	373
15	426·0	2·26	0·47	0·00	2·2	2·6	9·5	363
				MEAN OF FIVE (OR FEWER) ANALYSES.				
2	312·8	4·57	1·08	0·14	9·2	10·5	18·8	192
3&4	209·3	1·51	0·34	0·01	3·8	4·2	10·1	169
5	333·6	1·88	0·44	0·02	4·2	4·6	10·3	238
6	493·0	2·04	0·48	0·02	9·5	10·0	26·3	340
7	592·4	1·84	0·49	0·10	17·7	18·3	41·7	400
8	681·8	2·15	0·65	0·06	23·4	24·1	50·2	425
9	382·9	2·10	0·61	0·02	13·0	13·6	13·0	228
10	476·7	1·68	0·51	0·04	21·2	21·7	42·2	329
11	554·9	1·35	0·41	0·03	23·4	23·9	45·6	392
12	639·6	1·47	0·40	0·02	20·2	20·6	41·6	425
13	674·3	2·15	0·67	0·02	21·5	22·2	46·2	454
14	662·6	2·21	0·54	0·03	20·3	20·9	46·0	446
15	562·9	2·63	0·77	0·02	17·6	18·4	21·1	397
16	281·1	5·61	1·34	0·01	6·6	7·9	10·8	206

Frankland, and our own more recent work have established, it will be convenient to consider (1) the variations in the composition of the water due to the character and stage of the running; (2) the influence both of the manure and of the time of year. The quantity of nitrogen lost by drainage will be considered in the concluding section.

Influence of the Character and Stage of the Running.

We have already called attention, when speaking of the waters obtained from the drain-gauges, to the existence of two distinct kinds of drainage-water in our clay soils, one which has come directly from the surface through small channels in the soil, and the other which consists of the general discharge of the saturated soil; this fact is of considerable help in explaining the variations in composition observed in the drainage-waters from the same plot. Supposing that the soluble matter in a soil is *equally diffused* throughout it, the drainage-water will be weaker in proportion as surface-water preponderates in the discharge. This surface-water will consist partly of the discharge from the upper layer of soil, and partly of little altered rain-water, both of these gaining access to the drains through the channels in the soil. This drainage from the surface will precede the general discharge from the mass of soil above the drain-pipe. The admixture of rain-water will be most considerable during heavy rain, when water accumulates on the surface of the land, as water will then stand over the heads of all existing channels. Drainage from the surface will cease soon after rain has stopped, the upper layer of soil being the first to lose its supersaturated condition. As the running at the pipe diminishes, the drainage-water will be successively furnished by lower and yet lower layers of soil, till the soil is no longer in a supersaturated condition above the drain-pipe.

Under the conditions assumed, it is clear that the drainage-water collected at the commencement of a running will be much weaker than that collected at the end. A collection made during a heavy, long-continued rain, when the drains are rapidly discharging, will also be much weaker than a collection made from the same soil when the rainfall is moderate, and the discharge contains a less proportion of surface-water.

This is exactly what we observe in studying the composition of the drainage-waters obtained after the soluble manures have become diffused throughout the soil. One would perhaps have expected that the soluble salts (chlorides for instance) applied to the land as manure would appear in gradually diminishing

proportion in the drainage-waters, each succeeding discharge being weaker than the one preceding; this, however, is not the case. The soluble salts are indeed gradually removed in the drainage-waters, but weak discharges are followed by strong, and strong by weak, the composition of the water depending on the amount of the rainfall which occasions the outflow, and on the stage of the running at which the sample is taken.

There is usually a distinction visible to the eye between an outflow containing much direct channel water, and one consisting wholly of the true discharge from the soil; the former is usually more or less turbid, the latter always clear. The direct channel-water is, in fact, always turbid, save after hard frost, or shortly after the application of the artificial manures. We owe to W. Skey, and to Th. Schloesing, the observation that the presence of various salts, especially salts of calcium, determines the coagulation of the particles of clay. In Broadbalk Field the drainage-waters from the plots receiving ammonium-salts are especially bright for some little time after these salts have been applied; nitrate of sodium does not produce the same result. The reason of this fact is that ammonium-salts greatly increase the amount of lime in the drainage-waters, the sulphate or chloride of ammonium reacting upon the chalk of the soil, sulphate and chloride of calcium being produced, while nitrate of sodium produces no such effect.

An excellent illustration of the difference in composition of turbid and clear waters is afforded by Frankland's analyses of January 19, and February 26, 1873. On January 19 there was a small flow of the drains; all the waters were clear. The next running took place on February 26. There was again a small flow, resulting from the thaw of snow; all the waters were turbid. The mean composition of the dissolved matter in the drainage-water from Plots 7, 8, 10, 11, 12, 13, and 14 on these two dates will be found in Table XLII.

TABLE XLII.—COMPOSITION of CLEAR and TURBID DRAINAGE-WATERS from BROADBALK FIELD, in parts per MILLION. (DR. FRANKLAND.)

Date of Collection.	Total Solid Matter.	Carbon in Organic Matter.	Nitrogen as				Chlorine.
			Organic Matter.	Ammonia.	Nitrates and Nitrites.	Total Nitrogen.	
1873.							
Jan. 19 (clear) ..	543·9	1·21	0·39	·03	15·2	15·6	27·6
Feb. 26 (turbid) ..	311·3	2·96	0·78	·07	6·1	6·9	13·7

It will be seen that while the total solid matter, and especially the nitrates and chlorides, are greatly diminished in the turbid water, the organic matter and the ammonia have greatly increased. The excess of organic matter in turbid waters, and the increase in the proportion of carbon as the turbidity increases, have been already noticed when speaking of the waters from the drain-gauges; the same facts reappear in the analyses of the Broadbalk waters, as will be seen by a glance at the following numbers representing, in parts per million, the mean results found by Dr. Frankland for the waters from Plots 2–15.

Condition of Waters.	Number of Analyses.	Organic Carbon.	Organic Nitrogen.	Ratio of Nitrogen to Carbon.
Clear	20	1·34	0·44	1 : 3·03
Slightly turbid	32	1·87	0·47	1 : 4·01
Turbid	28	2·46	0·59	1 : 4·15
Very turbid	6	7·55	1·69	1 : 4·48

The proportion of carbon to nitrogen in the drainage-waters from cropped land is seen to be rather higher than in the waters from a bare fallow (see Part II. vol. xvii. p. 336).

As an illustration of the different composition of drainage-waters at the commencement and end of a running, we give on the next page the amounts of nitric acid and chlorine found in the drainage-waters collected on the evening of June 2, 1879, and on the morning of the following day. The evening collection was made about one hour after the drains had started running; the collection next morning was made when the drains were ceasing to run.

The increase in the chlorides and nitrates towards the end of the running is here extremely striking. The waters collected on June 2 were all more or less turbid, especially those from Plots 3 & 4, 5, 9, and 12–18. The waters caught on June 3 were all clear. This year the ammonium-salts were applied to Plot 15 in autumn, and to all other plots in the spring.

We have already stated that the rule that drainage-waters increase in strength towards the end of the running is true in all cases in which the soluble salts are at the time tolerably diffused throughout the soil; it applies, in fact, to those cases only. When soluble manures have recently been applied to the surface, the drainage-waters always *decrease* in richness towards the end of the running. In this case the layer of soil richest in soluble salts is considerably above the level of the drains. As after rain has ceased, the upper layer of soil will be the first to cease

TABLE XLIII.—CHLORINE and NITROGEN as NITRIC ACID in DRAINAGE-WATERS from BROADBALK FIELD collected near the beginning and end of a running, in JUNE 1879, in parts per MILLION.

Plots.	Manuring.	June 2.		June 3.	
		Chlorine.	Nitrogen as Nitrates.	Chlorine.	Nitrogen as Nitrates.
3&4	Unmanured	0·8	none	2·3	0·9
5	Mixed Mineral Manure	0·6	none	3·1	1·5
6	200 lbs. Amm. Salts and Mins.	12·6	0·9	23·6	4·0
7	400 lbs. " " "	22·3	3·0	43·0	6·5
8	600 lbs. " " "	38·9	9·3	58·4	13·8
9	550 lbs. Nit. Sodium and Mins.	2·2	12·0	7·6	31·7
10	400 lbs. Ammonium-Salts ..	34·8	16·2	61·4	25·7
11	Ditto, with Superphosphate ..	37·1	10·7	66·9	18·6
12	Ditto, ditto, with Sulph. Sodium	35·8	7·8	59·8	13·3
13	Ditto, ditto, with Sulph. Potass.	33·9	4·3	63·1	7·9
14	Ditto, ditto, with Sulph. Mag...	34·6	7·3	43·3	10·5
15	400 lbs. Amm. Salts and Mins.	4·5	3·2	12·1	7·9
17	Mixed Mineral Manure	2·5	none	7·3	1·5
18	400 lbs. Ammonium-Salts ..	29·7	3·9	56·7	7·7

discharging, while drainage will continue for some time at a diminishing rate from lower and lower layers of soil, it is plain that the waters will under these circumstances become weaker as the drain ceases to run.

The waters from several of the plots have been collected at frequent intervals while the drains were running, with the especial object of ascertaining if any alteration in the composition of the waters occurred. A selection of some of the more characteristic results recorded for Plots 12 and 13 during a single season will be found in Table XLIV. Numerous other hourly collections have been made, showing similar results.

The ammonium-salts were applied to Plots 12 and 13 on March 12, 1879. The first running of the drains occurred on April 7; the pipes had been running for at least an hour when the first collection was made; the size of the stream was then about two-tenths of the pipe. No rain fell during the collections; the waters were all clear. The result of the hourly examination made shows that both chlorides and nitrates had diminished to less than one-half of their first amount by the time the drains had ceased to run, eight hours after the first collection.

The next running took place on April 13. The pipes ran for at least an hour before the first collection at 2 P.M. The size of the stream at this time was about four-tenths of the pipe. The waters were clear. It will be noticed that the chlorides in the first collection at this date are much larger than they were at

TABLE XLIV.—ALTERATION in COMPOSITION of DRAINAGE-WATERS from BROADBALK FIELD during the course of their running: parts per MILLION.

Date of Collection.	Plot 12.		Plot 13.	
	Chlorine.	Nitrogen as Nitric Acid.	Chlorine.	Nitrogen as Nitric Acid.
1879.				
April 7, 7 A.M.	83·4	25·4	101·4	29·4
„ 8 „	68·6	..	83·6	..
„ 9 „	58·8	18·2	70·0	20·1
„ 10 „	53·4	..	62·2	..
„ 11 „	50·2	14·6	57·8	16·1
„ noon	47·0	..	54·4	..
„ 1 P.M.	43·4	12·6	50·0	14·0
„ 2 „	40·0	..	45·4	..
„ 3 „	37·6	11·2	43·8	..
„ 4 „	..	..	41·2	11·5
April 13, 2 P.M.	65·0	26·9	79·0	34·2
„ 4 „	59·0	21·2	66·2	23·9
„ 6 „	54·4	18·2	60·2	20·7
May 29, 7 A.M.	68·7	16·9	67·3	9·9
„ 10 „	73·3	17·6	76·0	13·4
„ 1 P.M.	68·6	17·2	63·8	16·6
„ 4.45 „	62·3	16·2	65·1	12·5
July 1, 10 A.M.	21·7	1·7	22·9	0·5
„ noon	30·1	2·1	23·6	0·5
„ 2 P.M.	33·1	2·9	34·7	0·9
„ 4 „	35·7	2·9	32·6	0·7
„ 6 „	36·2	3·4	30·6	0·4
„ 8 „	36·8	3·5	36·7	0·9
August 3, 8 A.M. ..	16·2	0·6	18·4	none
„ 10 „ ..	20·2	0·2	20·8	0·2
noon ..	22·6	0·6	23·1	none
„ 4 P.M. ..	22·7	0·6	25·3	0·4
1880.				
February 17, 8 A.M. ..	19·9	23·3	20·7	20·2
„ noon ..	21·2	23·3	23·0	22·1

the end of the previous running, the drains being now fed by the discharge of a higher layer of soil; the chlorides also do not fall so low at the close as in the previous case, the soluble salts having now become more equally diffused throughout the soil.

The drains ran for the next time on May 29; they had been

discharging for at least an hour when the first collection was made. The size of the stream at 7 A.M. was about half the pipe. The waters were then slightly turbid, and especially from Plot 13 ; the subsequent collections were all clear. During the first three hours it will be seen that the waters became stronger, but that afterwards they became decidedly weaker. We are here perhaps at the turning-point for the season : the layer of soil richest in chlorides lies now not far above the level of the drains.

The runnings of these plots on June 2 and 3 have been already given (Table XLIII.) ; the succeeding runnings on July 1 and August 3, 1879, and February 17, 1880, are given in Table XLIV. These are by no means the only runnings which occurred during the season, which was very wet, they are selected as giving a fair idea of the condition of the waters at certain characteristic periods. It will be seen that from June onwards the chlorides in the drainage-waters tend to increase as the flow of water diminishes, the upper soil being now poorer in chlorides than the soil immediately surrounding the drain-pipes.

The nitrates, being salts nearly equally diffusible with the chlorides, generally rise and fall with them, though frequently in very different proportion. Cases, however, may occur in which the chlorides and nitrates are not distributed throughout the soil in the same manner. As nitrification takes place most actively in the upper layers of soil, a band of nitrates may be formed near the surface of a soil in which the chlorides are equally diffused. In such a soil the nitrates may diminish in the drainage-water with a diminishing flow of the drains, while the chlorides increase. An excellent example of this is afforded by the runnings of Plot 15 on Nov. 15 and 16, 1880. Plot 15 had received its ammonium-salts on Oct. 25 ; heavy rain followed from the 26th to the 29th ; the chlorides were thus washed into the lower layers of the soil before any considerable nitrification had taken place. On Nov. 15, when the drains next ran, the surface soil had become rich in nitrates, the chlorides occupying a much lower level. In three successive collections the nitrogen and chlorine found were, in parts per million, as follows :—

	Nitrogen as Nitrates.	Chlorine.
November 15, 4 P.M. ..	67·8	39·0
" 16, 8 A.M. ..	50·0	60·6
" 16, 2 P.M. ..	34·6	63·1

The nitrates thus fell very considerably towards the end of the running, while the chlorides as strikingly increased.

Influence of the Character of the Manure and Time of Year.

In considering this division of the subject, we shall take first those facts which are shown only by Voelcker's or Frankland's analyses, and proceed afterwards to those which can also be illustrated by the later Rothamsted results.

Table XLV.—Mean of Ten Analyses of Broadbalk Drainage-Water, by Voelcker and Frankland, in parts per Million.

Plot.	Total Solid Matter.	Lime and Magnesia.*	Chlorine.	Nitrogen as Nitrates.	Nitrogen per Acre per Inch of Drainage.
	Per Million.	Per Million.	Per Million.	Per Million.	lbs.
2	367·2	123	19·4	11·5	2·60
3&4	227·8	99	10·4	3·9	0·88
5	329·8	132	10·7	4·7	1·06
6	450·3	171	23·5	9·0	2·04
7	542·4	207	33·9	15·9	3·60
8	615·1	222	44·8	20·2	4·57
9	405·7	126	12·4	16·0	3·62
10	441·8	173	37·1	17·6	3·98
11	490·4	197	38·6	19·4	4·39
12	585·3	218	36·3	17·7	4·01
13	609·3	232	41·4	19·5	4·41
14	630·6	244	42·7	19·8	4.48
15†	571·3	217	22·9	20·9	4·73
16	284·6	120	11·2	6·9	1·56

Two of the plots in Broadbalk provided with drain-pipes receive no manure. On Plot 3 & 4, one-half (3) has remained unmanured since 1840; while the other half (4) was last manured for the crop of 1851; and Plot 16 was last manured for the crop of 1864. The drainage-water from these two plots contains much less solid matter in solution than the water from any other plot in the field. The mean of Voelcker's and Frankland's analyses (Table XLV.) shows a contents of solid matter of 227·8 per million in the drainage-water from Plot 3 & 4, and 284·6 in the water from Plot 16. The principal constituents of this solid matter are calcium-salts, chiefly the carbonate.

* To obtain the mean figures for total lime and magnesia, Frankland's determinations of "Total Hardness" have been calculated into lime, and then averaged with Voelcker's results; the amount of magnesia present is so small that this mode of calculation involves little error.

† The mean of eight analyses of the water from Plot 15 is here given; five refer to a period when the ammonium-salts were applied in the autumn, as on the other plots, while three represent winter drainage after an autumn application of mineral manure only.

The superphosphate and the sulphates of potassium, sodium, and magnesium, applied to Plot 5, considerably increase the contents of the drainage-water, the dissolved matter rising to 329·8 per million. The sulphate of calcium present in the superphosphate, and the sulphate of sodium, are the chief constituents of the manure which appear in the drainage-water: the sulphates of potassium and magnesium also react on the lime contained in the soil, and furnish a further supply of sulphate of calcium to the water.

When ammonium-salts are applied to the land, the quantity of matter removed in the drainage-water is much increased; thus in the water from Plot 10, receiving 400 lbs. of ammonium-salts alone, the dissolved matter reaches 441·8 per million. When ammonium-salts are added to the mixed mineral manure, the solid contents of the drainage-waters rises in proportion to the quantity of these salts applied. Thus in the drainage-waters from Plots 6, 7 and 8, to which 200, 400 and 600 lbs. of ammonium-salts are applied, the mean proportion of total solid matter is respectively 450·3, 542·4, and 615·1 per million.

The solid matter removed from the soil by the agency of the ammonium-salts consists chiefly of sulphate, chloride, and nitrate of calcium. Probably the whole of the sulphuric acid and chlorine contained in the ammonium-salts unites with lime and magnesia in the soil; the resulting salts being soluble, they will be removed, to a greater or less extent, in the drainage-water as soon as a sufficient rainfall occurs. The 400 lbs. of ammonium-salts would be able to remove annually from the soil in this way about 172 lbs. of lime.* The actual loss of lime would, however, be somewhat less, as a part of the sulphuric acid and chlorine of the ammonium-salts would be retained by the crop. Loss of lime will also occur as nitrate of calcium. Ammonia is speedily oxidised to nitric acid in the soil; this acid combines with lime and magnesia in the soil, and nitrates appear in the drainage-water. Supposing that the whole of the ammonia were converted into nitric acid, and that the resulting nitrates were entirely lost by drainage, the soil would suffer a further loss of about 172 lbs. of lime for 400 lbs. of ammonium-salts applied. On a cropped soil, of course, the loss on this score would be greatly diminished, as the crop would assimilate a large part of the nitrates formed. The action of ammonium-salts in impoverishing a soil of lime and magnesia

* This amount of lime would of course not be removed in the first year of the application of ammonium-salts, unless the drainage were especially excessive. As, however, the soil became yearly richer in soluble calcium-salts, the drainage-water would increase in strength, until at last the loss by drainage balanced the annual receipt.

should always be borne in mind when their application to soils poor in lime is in question.

The nitrate of sodium applied on Plot 9, has apparently little or no influence in increasing the proportion of lime in the drainage-water. The mixed mineral manure being applied only on one-half (the *a* portion) of this plot, the amount of lime supplied is but one-half of that applied to Plots 5, 6, 7, 8, &c. Though receiving some lime in the manure, the quantity present in the drainage-water is less than in the water from Plot 10, receiving ammonium-salts without lime. This difference in action between nitrate of sodium and salts of ammonium is what we should expect, as there are no known chemical reactions within the soil by which nitrate of sodium could render lime or magnesia soluble.

From Plot 10 to 15 there is a gradual increase in the amount of lime contained in the water. It rises with the application of superphosphate of lime to Plot 11, and is still further increased by the sulphates of sodium, potassium, and magnesium, added to Plots 12, 13, 14; the two latter sulphates will have the greatest influence in removing lime, the potash and magnesia being to a large extent retained by the soil, while the sulphuric acid passes into the drainage as sulphate of calcium.

The steady increase in strength of the waters from Plot 12 to 15 is, however, much greater than can be accounted for by the above considerations, and is shared by nearly all their constituents; the waters from Plots 13, 14, and 15 are, indeed, among the strongest in the field, equalling or exceeding in strength the water from Plot 8. The special strength of the drainage from Plot 15 does not appear from the figures given in Table XLV. for the reason mentioned in the footnote. If we regard simply the five analyses made when all the plots received their ammonium-salts in the autumn, it will appear that the drainage-water from Plot 15 contained more nitric acid, more lime, and more total solid matter than that of any other plot in the field. As there is no obvious reason from the composition of the manure for this unusual strength of the drainage-water, the cause must be sought in some circumstance affecting the drainage at this part of the field. The subject will come again before us further on.

Plot 2, receiving farmyard-manure, yields a drainage-water containing a mean of 367·2 parts of solid matter per million; this is considerably more than that shown by the drainage from the unmanured plots, but much less than that yielded where ammonium-salts are applied. The water appears from Voelcker's two analyses to be especially rich in sulphates.

The magnesia applied occasions some, but not very much increase of magnesia in the drainage. With the exception of

the drainage from Plot 2, which shows a low proportion, the magnesia only ranges from 3·5 to 5·5 per cent. of the lime, and rises or falls with it. Plot 14, which receives nearly three times as much magnesia as Plots 5–8, is no exception, the magnesia in the water, though the greatest in absolute quantity, being still only 5·1 per cent. of the lime. Where sulphate of magnesium was applied (excepting on Plot 14) the amount of magnesia in the drainage alone, that is besides the smaller amount in the crops, was approximately the same as in the manure, but in the other cases the soil itself contributed not much less magnesia to the waters.

For the purpose of illustrating the annual losses of lime and magnesia which the soil suffers by drainage, we will assume that the annual drainage in Broadbalk Field amounts to 10 inches ($2\frac{1}{4}$ million lbs.), and that it has the composition shown by the mean analyses of Voelcker and Frankland given in Table XLV. The lime and magnesia annually lost by the unmanured Plot 3&4 will then be 223 lbs.; by Plot 5, receiving only mineral manure, 297 lbs.; by Plot 9, receiving nitrate of sodium and half a dressing of mineral manure, 284 lbs.; by Plot 10, receiving 400 lbs. of ammonium-salts only, 389 lbs.; by Plot 11, receiving 400 lbs. ammonium-salts and superphosphate, 443 lbs.; and by Plots 6, 7, 8, 12, 13, 14, receiving an average of 400 lbs. ammonium-salts, with the sulphates of potassium, sodium, and magnesium in addition, a mean of 485 lbs. per acre. A reference to Table XXXVIII. will show that the quantity of lime and magnesia in the usual dressing of mineral manure is 104 lbs., the amount lost is thus greatly in excess of that applied to the land. The estimates just given are probably rather below than above the truth.

The amount of phosphoric acid found by Dr. Voelcker in the drainage-waters was very small. The determinations made were few in number, and the results display little regularity. It is, in fact, left uncertain whether the amount of phosphoric acid is increased by the use of phosphatic manures, or whether it is influenced by the addition of ammonium-salts. The mean of all the determinations gives 0·93 of phosphoric acid per million of water. If we assume, as before, 10 inches as the average annual drainage in Broadbalk Field (in recent wet years the drainage would be much greater), the annual loss of phosphoric acid by drainage would be 2·1 lbs. per acre.

The determinations of potash are much more numerous than those of phosphoric acid; they also display great irregularity. It is quite evident, however, that where potash was applied in the manure, the amount is distinctly increased in the drainage-water. The drainage-waters from the six plots receiving no potash contain an average of 1·6, and the waters from the eight

plots receiving potash an average of 4·2 parts of potash per million. The former quantity would correspond, on the previous assumption, to a loss of 3·6 lbs., and the latter to 9·5 lbs. per acre per annum. As to the probable correctness of calculations based on this assumed amount of drainage we shall speak in the concluding section of the paper. In the absence of drain-pipes, a part of both the phosphoric acid and potash in the drainage-water would doubtless be retained by the subsoil.

The figures showing the amount of soda in the drainage-waters are much more regular than those for potash or phosphoric acid. The water from six plots receiving no soda contains a mean of 6·1 of soda per million. The water from five plots receiving 100 lbs. of sulphate of sodium annually contains a mean of 11·6 per million of soda. Where 366½ lbs. of sulphate of sodium are applied (Plot 12), the soda becomes 24·6 per million. Where 550 lbs. of nitrate of sodium are applied (Plot 9), the soda in the drainage is increased to 56·1 per million. As sodium-salts are very soluble, and the retentive power of soil for soda is very small, it is probable that with a regular supply of soda there will be a regular discharge of a nearly equal amount in the drainage-water. The quantity of soda annually assimilated by the wheat-crop is very small; on three only of the plots in Broadbalk does it exceed 1 lb. per acre.

The soda found in the drainage-water from the unmanured plots will be derived from rain; and to a smaller extent from diffusion from the neighbouring soil or subsoil. If we assume the chlorides present in the rain at Rothamsted to exist as common salt, the rain analysed during forty-three months, in 1877–80, would have supplied annually about 11·7 lbs. of soda. A part of the sulphates in rain may also exist as sodium-salts.

It is obvious that if the phosphoric acid and potash applied in manure have not escaped to any serious extent in the drainage-water, the portion unused by the crop must remain stored up in the soil. In October 1865, samples of soil were carefully taken from eleven of the plots in Broadbalk, representing the first, second, and third 9 inches from the surface. The soils from Plots 2, 3, 5*a*, 7*a*, and 10*a*, were examined by Hermann von Liebig.* He determined the substances soluble in boiling dilute acetic acid, and the amount of phosphoric acid soluble in dilute nitric acid. Assuming that all the soils were originally alike, and knowing the substances applied as manure, and removed in the crop from each plot, it becomes possible to

* "Bodenstatik und Bodenanalysen." 'Zeitschrift des landwirthschaftlichen Vereines,' 1872. Also Jour. Chem. Soc. 1872, 318, 837.

calculate what residue of each constituent of the manure should be found in the soil, supposing no loss had occurred by drainage. It was found on making the calculation that the phosphoric acid applied as superphosphate was pretty fairly accounted for, the excess of phosphoric acid being found stored up in the first and second 9 inches of the soil, but chiefly in the first. Of the potash applied, a considerable amount was found in the soil, chiefly in the first 9 inches, but a large quantity remained unaccounted for; as it was clear that very little had escaped in the drainage-water, Hermann Liebig concluded that it had been converted into a silicate insoluble in acetic acid. Of the sulphuric acid applied, only a small amount was found in the soils. Of the soda, no excess was found due to the manures applied, save in the soil receiving farmyard-manure. The sulphuric acid and soda, being diffusible bodies, had clearly been more or less completely removed in the drainage-water.

We may obtain evidence of the retention or non-retention by the soil or crop of many of the substances applied in the manure, by comparing the relative proportion of the constituents present in the manure with the relative proportion of the same constituents found in the drainage-water; if no constituent of the manure has been abstracted by the soil or crop, we shall find that the constituents of the drainage-water bear the same proportion to each other as in the manure; while any assimilation by the crop, or retention by the soil, will lower the proportion of the constituents thus appropriated in the drainage-water. Thus, taking seven plots receiving phosphoric acid, the mean proportion of sulphuric acid to phosphoric acid in the manures applied is 1000 : 194; but in the drainage-water from these plots the proportion is 1000 : 17, showing a large retention of the phosphoric acid. Again, taking the six plots receiving a full dressing of potash, we find that the mean relation of sulphuric acid to potash in the manure is 1000 : 273; while in the drainage-water from these plots the relation is 1000 : 50, showing a consumption or retention of more than four-fifths of the potash. On the other hand, the relation of sulphuric acid to soda in the manure of seven plots is 1000 : 253;* while in the drainage-water the relation stands 1000 : 271, showing that a little more sulphuric acid than soda has been taken up. In the manure of nine plots the relation of sulphuric acid to chlorine is 1000 : 367;* in the drainage-waters therefrom the proportion is 1000 : 382, showing that rather more sulphuric acid than chlorine has been retained. Thus while the phosphoric acid and potash are largely retained by

* In making these calculations the estimated amounts of sulphuric acid, chlorine, and soda in the rainfall of the seasons in question, have been added to the quantities applied as manure.

the soil and crop, the sulphuric acid, chlorine, and soda appear in the drainage-waters in nearly the same proportions as they exist in the manure, the crop taking up but little of these substances, and the soil exerting little if any detaining power over them. Of the three diffusible substances just named, the sulphuric acid is clearly the one most subject to appropriation. The crop of wheat on Plot 7 *b*, averaging 6217 lbs. of total produce per acre in 20 years (1852–71), assimilated yearly about 0·4 lb. of soda, 8·9 lbs. of chlorine, and about 15 lbs. of sulphuric acid.* Soil has also apparently a greater retentive power for sulphuric acid than for chlorine.

We have examples both in the analyses of Voelcker and Frankland of the alteration in the composition of drainage-waters at different periods of the same season. In Table XL. and in Table XLI. will be found analyses of waters collected from all the plots in January, and again in the middle or end of spring. The drainage-waters are naturally strongest soon after the application of the manures. As the whole of the manures (excepting the nitrate of sodium) were applied in October at the time to which these analyses refer, the winter drainage-waters are, in this case, the strongest. In spring the total solid matter dissolved in the water is seen to be much diminished, save in the case of Plot 9, which received a heavy dressing of nitrate of sodium in March. The diminution in strength as the season advances is greatest in the case of the plots most heavily manured, and is least in the water from the unmanured land.

A nearer inspection of the figures shows that the spring waters are not only weaker, but of a different composition from those collected in winter. The dissolved matter of the spring waters contains as large a proportion of lime as the dissolved matter of the winter waters, and perhaps rather more magnesia, but the lime and magnesia are differently combined. The amount of nitric acid, sulphuric acid, and chlorine has greatly diminished since the winter, and the lime is now largely held in solution by carbonic acid; the waters of the manured plots thus more nearly approach the waters from the unmanured plots in their composition. The chlorides seem to be washed out of the soil rather more speedily than the sulphates, which are often of less solubility, and for which, as already mentioned, the soil possesses a small chemical retentive power. The striking disappearance of the nitrates in spring is in part due to the active growth of the wheat-crop at this season; we shall return to this part of the subject again.

* The sulphuric acid assimilated is reckoned approximately from the total sulphur contained in the crop.

The remaining constituents of drainage-water that we have to mention, namely the chlorides, ammonia, and nitrates, bring us to the point at which we can make use of the additional facts furnished by recent work at Rothamsted. As any detailed statements must be omitted for want of space, we can only consider the general facts which the results of the analyses teach.

Chlorine is an element of very little agricultural importance. The wheat-crops in Broadbalk Field assimilate very little of the chlorides applied in the manure; in the corn practically no chlorine is found; in the straw only a small and variable quantity. Regarded simply as plant-food, chlorides might easily be dismissed from consideration. For our present purpose, however, the chlorides have a special and very considerable importance. Chlorides and nitrates are both salts for which soil possesses apparently no chemical retentive power; they are held by soil merely as in a sponge: their distribution in the soil is thus regulated by the amount of rain falling on the surface, and by the ordinary laws of diffusion. As the amount of chlorine applied to each plot in the manure is with a single exception (Plot 2) fairly well known, the proportion of chlorine contained in the drainage-water becomes an excellent indication of the extent to which the soluble constituents of the manure have been washed out of the surface soil; it enables us to judge of the relative concentration of the water issuing from different pipes; it also indicates in certain cases whether a mixture of the drainage-waters has taken place. A good instance of the important lessons which may be learnt from a series of chlorine determinations has been already afforded when considering the alteration in composition of drainage-waters in different stages of their running (Table XLIV.). Facts ascertained with regard to chlorides will be equally true of the other soluble diffusible salts present in the soil.

In Tables XLVI. and XLVII. will be found a summary of the amount of chlorine, and of nitrogen, in the form of nitric acid, occurring in all the principal runnings of the drain-pipes during three years, November 1878 to October 1881. These years include long periods of exceptionally high rainfall, in which the drains ran with unwonted frequency; they furnish, in all, instances of 49 runnings in which nearly every pipe participated, and thus afford material for trustworthy averages, showing the relative character of the discharge from each plot. Excepting during the first $3\frac{1}{2}$ months, the drainage system of the field was also for the whole of this period provided with the later improvements already mentioned (page 4).

The form of the Tables is arranged so as to aid the study of the

production and removal of nitrates. The so-called "Winter" season begins with the sowing of the manures towards the end of October, and continues till the sowing of spring manures early in March. The so-called "Spring" coincides with the early growth of the crop, and concludes with the end of May. "Summer" is here reckoned as the period in which the crop has full possession of the land, and lasts from the beginning of June to the commencement of harvest. "Autumn" is reckoned from harvest to the date of manure sowing in October. For each of these four periods the analysis of the first and last general running of the drains is given, whenever such occurred, with the mean of all the general runnings in the period. The progressive alterations in the composition of the water are thus plainly shown.

In reading Table XLVI. we must remember that 100 lbs. of chloride of ammonium are applied to Plot 6, 200 lbs. to Plot 7, and 300 lbs. to Plot 8; while Plots 10, 11, 12, 13, 14, 15, and one of the alternating Plots 17 and 18, receive annually 200 lbs. Plots 3 & 4 and 16 are unmanured, and receive only the chlorine contained in the rain (see Part I. of this paper). Plots 5, 9, and 19 have no chlorine intentionally supplied in the manure, but the first two will receive a little, owing to the accidental impurities of commercial salts. The plot of the alternating series, 17 and 18, which receives the mineral manure, will have more or less of unwashed-out chlorides remaining in the soil from the application of ammonium-salts in the preceding year. Plot 19 will also contain some residue of its previous manuring with chlorides.

During the whole of the three seasons (1878–9 to 1880–81) included in the present tables, the ammonium-salts have been applied to Plot 15 in the autumn, and to all other ammonia plots in the spring. Of the alternating plots (17 and 18), Plot 17 received the ammonium-salts in the spring of 1878 and 1880; and Plot 18 in the spring of 1879 and 1881. The nitrate of sodium on Plot 9 has always been applied in the spring.

A glance at the results in Table XLVI. will show that the drainage-waters are all extremely rich in chlorides immediately after the application of the ammonium-salts.* The amount of chlorine in the first runnings of the plots receiving 200 lbs. of chloride of ammonium has averaged 89·7 per million during the three years in question, has frequently exceeded 100, and in one case reached 160 per million. The amount of chlorine in the drainage-waters reaches its minimum at the end of the

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* The first running in November 1878, given for Plot 15 (Tables XLVI. and XLVII.) shows far less chlorine, and less nitric acid than would be generally present in the first running of this plot. The running on November 28 is in fact not the first running; a large running took place on November 10, of which, unfortunately, we have no analyses.

TABLE XLVI.—CHLORINE in BROADBALK DRAINAGE-WATERS at different SEASONS o[f] the YEAR, with the AVERAGE AMOUNT in THREE YEARS (1878-9 to 1880-1), i[n] parts per MILLION.

DATE OF RUNNING.	PLOTS. 2.	3&4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19
WINTER (October 15—March 10), 1878–9.																	
November 28	..	8·0	8·5	12·8	17·6	36·7	8·6	23·6	25·4	25·6	25·9	22·1	51·5	6·8	19·2	6·7	8·
February 16	..	3·6	4·0	8·0	8·4	14·6	4·2	10·6	10·1	9·9	11·4	11·0	23·9	4·0	10·8	4·2	..
Mean 9 runnings	6·8	5·1	5·4	8·1	9·2	17·6	5·0	12·9	14·0	13·4	14·1	13·2	30·1	5·0	11·1	4·8	6·
SPRING (March 11—May 30), 1879.																	
April 7	..	4·4	4·9	63·0	102·4	91·4	12·4	70·6	61·2	83·4	101·4	119·2	14·4	4·7	8·0	160·0	..
May 29	1·5	2·4	2·6	18·6	45·5	70·0	6·9	59·9	71·7	65·5	66·2	69·6	8·0	2·7	5·6	51·0	3·
Mean 3 runnings	1·5	3·6	3·8	40·6	69·6	73·7	9·0	66·6	60·1	71·3	82·2	98·4	9·8	3·6	6·0	98·8	3·
SUMMER (June 1—September 3), 1879.																	
June 3	0·4	2·3	3·1	23·6	43·0	58·4	7·6	61·4	66·9	59·8	63·1	43·3	12·1	..	7·3	56·7	..
August 28	..	1·7	1·8	10·2	18·4	26·2	2·1	19·6	20·8	22·2	23·7	25·5	5·3	1·5	3·4	19·7	..
Mean 9 runnings	0·3	1·3	1·5	11·8	20·5	30·7	3·1	29·6	31·9	30·7	30·8	31·4	6·0	1·9	3·9	26·0	1·
AUTUMN (September 4—October 21), 1879.																	
October 1	..	5·8	5·1	13·3	17·6	..	5·4	16·7	17·6	18·3	18·1	..	..	..	3·3	16·2	..
WINTER (October 22—March 8), 1879–80.																	
Feb. 16, 17, 19 (Mean)	15·7	9·9	11·7	15·0	17·6	22·5	10·7	15·7	20·5	21·4	23·0	21·0	120·3	10·0	9·9	21·7	15·
SPRING (March 9—May 30), 1880.																	
April 15	..	6·9	7·0	51·2	138·8	98·0	10·0	90·0	55·2	57·5	92·7	..	..	6·8	96·0	..	.
Autumn (August 14—October 24), 1880.																	
September 14	12·3	11·6	12·2	37·1	77·6	167·2	12·0	64·7	85·4	81·3	102·8	79·2	21·9	9·3	52·2	15·7	8
October 10	..	5·4	5·2	14·3	21·4	34·3	5·6	27·8	33·7	32·8	37·8	34·6	19·6	4·7	27·3	9·2	5
Mean 5 runnings	8·0	8·2	7·7	19·9	41·4	68·3	8·3	38·2	52·9	49·6	60·1	48·0	24 4	6·7	42·3	11·6	7
WINTER (October 25—March 11), 1880–1.																	
Oct. 27, 28, 29 (Mean)	9·2	5·7	7·0	13·0	23·6	28·6	5·9	20·7	24·7	22·7	26·3	22·8	101·4	7·1	20·6	6·7	7
Mar. 5, 6, 7 (Mean)	2·7	4·3	4·4	8·1	9·8	10·8	4·2	9·0	9·8	8·7	9·4	8·7	14·2	4·2	7·1	4·5	4
Mean 17 runnings	5·9	4·7	5·1	9·2	13·1	15·2	4·6	12·7	14·5	12·8	14·5	13·2	39·5	5·3	11·6	5·7	5
AUTUMN (August 8—October 27), 1881.																	
August 30	..	6·0	6·2	44·6	61·0	..	..	70·8	67·2	79·4	77·6	..	..	4·5	6·6	..	
October 23	..	9·2	8·6	17·4	28·9	45·1	12·1	29·7	42·4	42·8	38·0	40·6	18·4	9·6	13·0	27·5	1
Mean 4 runnings	..	7·7	7·6	35·9	45·0	45·1	12·1	53·5	62·3	69·5	62·3	40·6	18·4	7·6	12·1	27·5	1

AVERAGE OF THREE YEARS (November 1878—October 1881).

	PLOTS. 2.	3&4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17 & 18. Am.	Min.
Mean of 49 (or fewer) runnings	6·1	4·9	5·2	14·0	23·1	30·8	5·7	24·2	26·1	25·7	28·9	27·8	32·5	5·1	25·4	6·2

TABLE XLVII.—NITROGEN AS NITRIC ACID in BROADBALK DRAINAGE-WATERS at different SEASONS of the YEAR, with the AVERAGE AMOUNT in THREE YEARS (1878–9 to 1880–1), in parts per MILLION.

DATE OF RUNNING.	Plots. 2.	3&4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.
WINTER (October 15—March 10), 1878–9.																	
November 28	..	5·5	4·9	4·9	3·9	6·7	9·9	7·6	6·7	5·9	5·5	6·6	32·9	5·4	4·0	4·9	13·3
February 16	..	3·4	3·7	4·3	3·5	4.5	5·6	5·2	4·8	4·1	3·8	4·8	18·4	4·2	3·3	4·2	..
Mean 9 runnings	8·2	4·7	4·5	4·2	3·6	4·8	6·3	5·7	5·5	4·6	4·6	5·7	21·6	5·3	3·4	4·9	10·4
SPRING (March 13—May 30), 1879.																	
April 7	..	3·6	2·9	22·5	39·0	36·6	68·9	45·4	41·8	25·4	29·4	33·0	9·6	3·6	2·3	40·4	..
May 29	3·6	1·6	1·1	3·7	9·3	19·7	32·7	27·1	21·3	16·6	11·2	16·1	6·4	1·5	1·5	9·0	3·7
Mean 3 runnings	3·6	2·5	1·9	14·2	25·3	28·4	44·9	34·5	28·0	23·0	24·9	31·6	6·7	2·3	1·5	30·6	3·7
SUMMER (June 1—September 3), 1879.																	
June 3	2·2	0·8	1·4	4·0	6·6	13·8	31·8	25·8	18·6	13·3	7·9	10·5	7·9	..	1·4	7·7	..
August 28	..	none	none	none	none	0·6	2·6	5·4	0·9	0·6	0·4	0·8	1·6	none	none	0·2	..
Mean 9 runnings	1·4	0·1	0·2	0·7	1·4	3·9	9·1	11·4	5·8	3·7	1·9	3·4	2·9	0·1	0·3	1·8	0·5
AUTUMN (September 4—October 21), 1879.																	
October 1	..	1·6	1·5	0·5	1·5	..	3·3	4·2	1·2	2·3	1·4	..	..	..	0·8	1·1	..
WINTER (October 22—March 8), 1879–80.																	
Feb. 16, 17, 19 (Mean)	27·3	13·5	16·8	16·2	15·9	22·1	19·1	17·1	22·7	22·0	20·9	21·1	77·0	15·9	16·0	16·5	33·0
SPRING (March 9—May 30), 1880.																	
April 15	..	4·6	5·6	16·0	32·2	27·6	66·7	22·9	19·1	21·3	30·7	..	..	6·5	27·0	..	..
AUTUMN (August 14—October 24), 1880.																	
September 14	8·2	4·1	5·7	6·9	7·4	24·1	30·8	21·0	9·1	8·4	7·7	7·7	5·2	4·5	8·8	6·0	5·6
October 10	..	4·8	4·5	6·4	5·4	9·3	13·1	13·7	9·3	8·6	7·6	7·2	7·8	5·9	7·2	5·9	7·2
Mean 5 runnings	6·0	4·7	4·5	5·6	6·3	11·6	16·0	13·7	8·5	7·6	7·1	6·7	6·4	4·6	6·7	5·6	6·3
WINTER (October 25—March 11), 1880–81.																	
Oct. 27, 28, 29 (Mean)	6·9	4·6	5·3	5·5	6·1	8·5	9·8	10·4	8·0	7·7	7·5	7·5	15·4	5·6	6·8	5·0	8·1
March 5, 6, 7 (Mean)	5·1	3·4	3·6	3·9	3·9	5·3	5·2	5·9	5·4	4·8	4·5	5·1	11·6	3·1	3·9	3·9	12·1
Mean 17 runnings	6·5	3·7	4·0	4·2	4·5	6·2	6·6	5 7	6·2	5·8	5·4	5·8	22·9	4·0	4·6	4·0	10·8
AUTUMN (August 8—October 27), 1881.																	
August 30	..	0·9	1·4	1·9	4·1	—	—	16·1	6·8	2·3	2·4	..	..	0·3	0·4	..	..
October 23	..	8·7	9·5	13·3	18·5	23·0	21·8	16·2	19·6	15·2	14·5	15·0	13·1	8·6	10·7	11·6	14·9
Mean 4 runnings	..	5·2	6·3	8·6	11·3	23·0	21·8	18·5	12·4	8·5	8·6	15·0	13·1	5·4	7·4	11·6	14·9

AVERAGE OF THREE YEARS (November, 1878—October, 1881).

	Plots. 2.	3&4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17 & 18. Am.	17 & 18. Min.	19.
Mean of 49 (or fewer) runnings	7·5	3·9	4·2	5·4	6·8	9·3	12·5	10·7	9·0	7·9	7·6	8·5	19·3	4·5	7·1	4·3	10·4

year's drainage, immediately before the fresh application of manure. The minimum for Plot 15 occurs at the end of autumn, and that for the other plots receiving ammonia at the end of winter.

The amount of chlorine present in the drainage-water at the period of minimum varies much, according to the amount of washing out by rain during the preceding year. The average amount of chlorine per million of water for seven plots receiving 200 lbs. of chloride of ammonium was 10·3 on February 16, 1879; 20·1, for the mixed runnings of February 16, 17, 19, 1880; and 8·9 for the mixed runnings of March 5, 6, 7, 1881.

The amount of chlorine present in the drainage-waters at the different seasons is extremely variable. Thus, on October 1, 1879, the average amount of chlorine in the drainage-water of six plots was 17·4 per million. On October 7, 1880, at 2 P.M., the water from the same six plots, running at about the same rate, contained an average of 33·1 per million. On October 14, 1881, four of the same drains ran, the water giving an average of 67·3 of chlorine per million. In these instances the strength of the water entirely depends on the amount of washing out the soil has previously suffered.

Where dry weather has occurred after the application of the chlorides they may remain for many months above the level of the drains, and when a running of the drains occurs, the water may be as rich in chlorides as if they had been quite recently applied. Illustrations of this will be found in the runnings of September 14, 1880, of February 16, 1880 (Plot 15), and of August 30, 1881; see Table XLVI.

On the other hand, wet weather may greatly diminish the amount of chlorides in the soil, *even when the drains do not run.* Thus, Plots 7, 10, 11, 12, and 13 ran in August 1881, yielding waters rich in chlorides; they ran also in September and in the earlier part of October. Plots 8, 14, and 18 did not run before October 23, but instead of yielding strong waters as the other plots did on their first running, they yield waters which are quite comparable with those of the now partially washed out Plots 7, 10, 11, 12, and 13. The loss of soluble salts suffered by the soil may thus be greatly in excess of the actual pipe-drainage.

There is some indication that when a period of severe washing out is followed by a considerable interval of dry weather, the drains on again commencing to run will yield water stronger than what they yielded on leaving off: compare the runnings of August 28, and October 1, 1879, with those of February 16, 1880; and the last runnings of Plots 3&4, 5, 9, 15, 16, 17, 19, in March 1881, with their first

runnings in the autumn of the same year; see Table XLVI. The increase of chlorine observed in these instances is much the greatest in the case of Plots 3 & 4, 5, 9, 17, receiving no chlorides. Supposing soluble salts have been washed below the level of the drains, it is natural to suppose that they would to some extent rise again by diffusion when the downward passage of water ceases, or that the water containing them in solution would be brought again to the surface by capillary attraction during dry weather. Simple diffusion would seem, in the examples just quoted, to have been the most active agent at work, the increase of chlorides being by far the most considerable in the case of plots very poor in this constituent; these plots have clearly, during the period of rest, obtained chlorine from the subsoil water.

The average figures at the foot of Tables XLVI. and XLVII. are the means of 49 analyses in the case of Plots 5, 6, 7, 9, 11, 12, 13; of 48 analyses in the case of Plots 3 & 4, 10, 17, 18; of 47 in the case of Plots 8, 15, 16; and of 43, 32, and 25 analyses in the case of Plots 14, 19, and 2 respectively.

The average amounts of chlorine are, with one exception, considerably below the earlier results of Voelcker and Frankland (Table XLV.). This is chiefly due to the very wet character of the last three seasons, and the consequent dilution of the drainage-waters.

Looking first at the plots receiving no chlorides in the manure, we see that the unmanured Plot 3 & 4 has given on an average 4·9, and the unmanured Plot 16, 5·1 of chlorine per million of drainage-water. Plot 5, receiving mineral manure, gives 5·2; and Plot 9, with nitrate of sodium, and a dressing of mineral manure on half its surface, gives 5·7 of chlorine per million.

The absence of any considerable amount of chlorine in the waters of these plots is the practical test that a mixture of drainage-waters has not taken place, but that each water fairly represents the plot to which it belongs. Plot 9 is most capable of acting as a test plot in this respect, lying as it does between two plots receiving chlorides, and one of them (Plot 8) receiving the largest amount of chlorides of any in the field. In earlier years the drain-water from Plot 9 occasionally contained much chlorine, probably through mixture with surface-water. In a running on December 8, 1868, Frankland found 60·0 per million of chlorine; in a running on April 11, 1878, we found 30·3 per million. Since, however, the improved drainage arrangements have been in action, the highest amount of chlorine found in the drainage for this plot has been 14·7 per million, which occurred

on October 23, 1881, in a first running after a cessation of drainage for six months. That a small amount of diffusion of soluble salts does take place, whereby the unmanured plots are somewhat enriched (diffusion is always from the stronger to the weaker solution) is probably true, but it is apparently limited to times of rest. So long as water is passing from above downwards, the manured or unmanured condition of the surface soil is sharply represented in the drainage-waters; but when active drainage ceases, a very slow general diffusion will take place if the soil continues sufficiently wet, the result being that the richest plots lose and the poorer plots gain somewhat in soluble salts.

The farmyard-manure plot shows but a small quantity of chlorine in its scanty runnings, the amount, 6·1 per million, exceeding by very little the quantity in the drainage from the unmanured land.

Turning next to the average amount of chlorine from plots receiving chloride of ammonium, we may note that the differences between Plots 6, 7, and 8 are such as we should expect to exist in the case of plots receiving respectively 100 lbs., 200 lbs., and 300 lbs. of a chloride in the manure. If we deduct the chlorine found for Plot 5 from that yielded by Plot 6, we obtain 8·8 as the increase of the chlorine due to 100 lbs. of chloride of ammonium. Adding this figure to the chlorine found for Plot 6, we obtain 22·8 as the amount of chlorine proper for Plot 7; the figure actually found being 23·1. Adding again 8·8 to 22·8, we obtain 31·6 as the amount of chlorine proper for Plot 8, the figure actually found being 30·8. The chlorine in the drainage-waters thus corresponds fairly with the chlorine applied in the manures, and we may consequently assume that Plots 5 to 8 are really comparable in their amounts of drainage, though varying a good deal in the amount of visible discharge at the pipes.

When we turn to the other plots receiving chlorides the results are not so agreeable. Plot 10, indeed, receiving the same amount of chlorides as Plot 7, gives also a very similar proportion in its drainage-water; but Plots 11, 12, 13, 14, 15, and 17, though receiving the same quantity of chlorides in their manure, yield, all of them, a considerably larger proportion in the drainage-water, the quantity of chlorine rising on Plot 13 to 28·9, and on Plot 15 to 32·5 per million. Plot 13, which receives the same amount of chlorides, and at the same time as Plot 7, thus yields one-fourth more chlorine in its drainage-water. To what is this to be attributed? On turning to the chlorine determinations of Voelcker and Frankland (Table

XLV.) we find the same increased proportion of chlorine in the waters from Plots 10–14,* and the increase is in much the same proportion, an addition of one-fourth to the chlorine of Plot 7, giving a figure between those actually found for Plots 13 and 14. In the same Table we find that the lime and magnesia, and the total solid matter in the drainage-water participate in the increase. It is evident, therefore, that the drainage-waters at this side of the field are for some reason rather more concentrated than those collected at the other side. A reference to the plan of Broadbalk field (opposite first page) will show that the drain-pipes collect a portion of their water from an unmanured margin at the top and bottom of the field, and that the length of this margin is much greater at the right side than at the left side of the field, we should expect therefore that the pipes lying towards the left would deliver a rather stronger water than those lying towards the right. This, however, is not a sufficient cause for the difference observed, and we must assume, what is very likely, that a different proportion of surface water gains access to the pipes in different parts of the field. We have dwelt on this point somewhat fully, as it is important we should not attribute to the character of the manure an effect that may be merely due to the condition of the drain-pipes.

On Plot 15 the chlorides are applied in October instead of in spring, as on the other plots; this fact probably accounts for the increase of chlorine over that given by the adjoining Plots 13 and 14. The quantity of chlorine applied to all these plots has been the same, but it has been subjected to different seasons of drainage. The water from Plot 15 was indeed much poorer in chlorides at the end of the three years than at the commencement; while with Plots 13 and 14, and others receiving ammonium-salts in the spring, the contrary was the case. The two series of plots do not therefore admit of an exact comparison, and it will require a longer period of experiment to decide whether a larger amount of chlorine is generally contained in the drainage-water of the autumn-sown Plot 15 than in that of the spring-sown Plots 13 and 14; but from the results of Voelcker and Frankland we should expect that this will prove to be the case.

We turn now to a part of the subject of far greater practical importance, namely, the evidence which the drainage-waters of Broadbalk afford, both as to the production of nitrates in the soil, and their removal from it by drainage. We must bear in mind throughout this part of the discussion that the

* Plot 15 had at this time a different manure supplying less chlorine.

nitrates of the soil furnish the chief, if not the only, supply of nitrogen available to a wheat-crop.

The production of nitrates in an unmanured soil kept free from vegetation has been discussed in Part II. of the present paper. It then appeared that the drainage-water collected during the last four years from the soil drain-gauges contained on an average 10·7 parts of nitrogen, as nitric acid, per million of water. The soil of these drain-gauges was ordinary arable soil, undisturbed in its condition, and had been maintained for ten years without manure or crop, and kept free from weeds.

When we turn to the nitrogen as nitrates found in the drainage-waters from the unmanured plots in Broadbalk field (Table XLVII.), we find that the quantity is far smaller than in the water from the drain-gauges. The average figures for three years given at the foot of the table, show that the mean amount of nitrogen is 3·9 per million in the case of Plot 3 & 4, permanently unmanured, 4·3 per million in the case of two plots receiving only ash constituents, and 4·5 in the case of the unmanured Plot 16. This much lower proportion of nitrates in the drainage-water is doubtless partly owing to the great exhaustion of the nitrogen of the soil by continuous wheat-cropping without manure, but is chiefly due to the fact that the crop actively appropriates the nitrates formed in the soil. So complete is the appropriation of nitrates by the wheat-crop, that during the time of active growth, and for some time after, no nitric acid, or a trace only, can be found in the drainage-water from several of the plots in Broadbalk. This is well shown by the analyses of Frankland of drainage-waters collected on May 18, 1872 (Table XLI.). In a later collection on June 11 of the same year Frankland found no nitric acid whatever in the waters from Plots 3 & 4, 5, 6, 7, 13. Similar results were found in the analyses made at Rothamsted of the waters collected during the summers of 1878 and 1879.

In autumn nitric acid again begins to appear in the drainage-waters of the plots unmanured with nitrogen, and continues steadily to increase if no serious loss by drainage takes place. Even, however, with an excessive amount of drainage a certain proportion of nitric acid is fairly maintained throughout the winter months, the production of nitrates generally keeping pace with their removal. The best illustration of the increase of nitrates during autumn on land unmanured with nitrogen, is afforded by the analyses of the drainage-waters from Plots 3&4, 5, 16 and 17, in August and October 1881. The maintenance of the nitrates during extremely wet winters is shown by the analyses of waters during the winters of 1878–9 and 1880–1.

The considerable accumulation of nitrates that may occur in a dry winter is illustrated by the composition of the runnings in February 1880. All the analyses referred to will be found in Table XLVII. The general character of the waters at different seasons of the year is also illustrated by Table XLVIII.

The results yielded by the drainage-waters from plots receiving ammonium-salts are full of interest. Soil, as is well known, has a wonderful retentive power for ammonia, and this is one reason why ammonia is so seldom present in drainage-waters. In Voelcker's and Frankland's analyses of Broadbalk waters mere traces of ammonia were found, the amount being generally below that in ordinary rain-water. Our own examinations of Broadbalk waters lead to the same conclusion. We have, however, one instance in which ammonia was found in the drainage-water in considerable quantity. The usual dressing of 400 lbs. of ammonium-salts per acre had been applied to Plot 15 on October 25, 1880, and the manure ploughed in. Heavy rain occurred during the night of the 26th, so that on the morning of the 27th all the drain-pipes, save those of Plots 2 and 19, were found running. The water collected from Plot 15 at 6·30 A.M. contained nitrogen, as ammonia, equal to 9·0 per million; a later collection at 1 P.M., contained 6·5 per million. Rain still continuing, collections of water were also made on the two following days. On the 28th the water collected at 6.30 A.M. contained 2·5 per million of nitrogen as ammonia. On the 29th, at 10·30 A.M., the quantity was 1·5 per million. Ammonia is absorbed by soil from a solution of salts of ammonium, only when the soil contains a sufficient quantity of some base capable of uniting with the acids of these salts. The Rothamsted soil contains but little chalk; it was clearly unable to decompose the ammonium-salt sufficiently quickly to prevent loss of ammonia.

It is evident that the first result of the application of ammonium-salts to the Rothamsted soil is the chemical absorption of the ammonia; the acids of the ammonium-salts at the same time unite with the lime in the soil, and may be removed in the drainage-water. Thus the water mentioned above as containing 9·0 parts of nitrogen as ammonia, contained 146·4 parts of chlorine derived from the ammonium-salts. If the soil is sufficiently moist to allow of the reaction just described, nitrification of the absorbed ammonia will rapidly take place. In the instance before us nitrification had made distinct progress in 40 hours. On October 10 the drainage-water from Plot 15 contained 8·4 of nitrogen per million in the form of nitrates. On the morning of October 27, about 40 hours after the application of the ammonium-salts, the nitrogen as nitrates in the water had risen to 13·5 per million. By November 15, 21 days after

sowing the manure, the nitrogen as nitrates in the drainage-water had reached 67·8 per million.

The speed with which nitrification takes place is largely dependent on the amount of rain which falls after the ammonium-salts have been applied to the soil; water is required in the first place for the solution and distribution of the ammonium-salt, and afterwards for the process of nitrification.

The product of nitrification appears to consist entirely of nitrates; traces only of nitrites have been found in the drainage-waters from Broadbalk, and these are very possibly the result of a reduction of nitrates previously formed.

It follows, from the quick nitrification of the ammonium-salts, that the drainage-waters from plots receiving ammonia are richest in nitrates shortly after the ammonium-salts have been applied. When the ammonium-salts are applied in March, as they are now on all plots, excepting Plot 15, the April waters are those strongest in nitrates. The mean of 27 analyses of waters collected in April from plots receiving 400 lbs. of ammonium-salts in March gives 29·6 of nitrogen as nitrates per million of water. The maximum observed has been 45·4. The average loss of nitrogen as nitrates in the April waters thus corresponds to 6·7 lbs. per acre, or to 42·8 lbs. of nitrate of sodium, for each inch of drainage.*

When the wheat-crop commences its active growth the amount of nitric acid in the drainage-water greatly diminishes, and in the case of some of the plots receiving ammonia the nitrates disappear altogether in summer time. The plot in which nitrates first disappear from the drainage-water is naturally Plot 6, as here only 200 lbs. of ammonium-salts are applied.

The various plots receiving 400 lbs. of ammonium-salts per acre differ very much as to the extent of the reduction in the nitrates effected by the growing crop, the amount of reduction depending entirely on the power of the crop to assimilate nitrogen. Thus on Plots 7 and 13, which receive both superphosphate and potassium-salts, and thus furnish the crop in abundance with its most essential ash constituents, the power of the wheat to assimilate nitrogen is at its highest, and the nitrates may disappear altogether from the drainage-waters in the course of the summer. In complete opposition to this stands Plot 10, to which ammonium-salts are applied without any of the ash constituents of the wheat-crop, and where, by long-continued treatment of this description, the available ash constituents of the soil have become greatly exhausted. On this plot the nitrogen applied is much in excess of the power of the crop to assimilate it, and conse-

* One lb. of nitrogen will be contained in 6·4 lbs. of good nitrate of sodium.

quently the drainage, even in summer time, always contains a large amount of nitrates. Intermediate between the two descriptions of manuring just mentioned stands Plot 11, which receives superphosphate, but no potassium-salts; here more nitrogen is taken up by the crop than on Plot 10, and less appears in the drainage-water; but the assimilating power of the crop being limited by the scarcity of potash its action does not nearly equal that of the crop on Plots 7 or 13. Plots 12 and 14, receiving respectively sulphate of sodium and sulphate of magnesium, together with the superphosphate, and having some residue of potash from early applications, stand intermediate between Plots 11 and 13 as to the proportion of nitrates assimilated by the crop, and consequently diverted from the drainage-water. An examination of the drainage from the various plots in summer time thus affords an excellent indication of the relative rate of assimilation of nitrogen taking place in the crops of the different plots.

In autumn the drainage-waters still reflect the results produced by the crop during summer. Where the crop has left a considerable residue of nitrates unassimilated, there the drainage-waters contain nitrates in considerable quantity, but where the crop has appropriated the nitrates in the soil there only small quantities are to be found in the drainage. During winter the waters equalise much in composition. If drainage is at all considerable, the soils which at the end of summer were richest in nitrates gradually lose their excess, while fresh nitrification maintains, or increases, the amount of nitrates in the soils which contained a smaller quantity.

On Plot 8 a larger quantity of ammonium-salt is applied than on any other plot in the field. There is here at all times an excess of nitrogen over the requirements of the crop; nitrates are thus found in the drainage-water throughout the summer, and they are maintained both in autumn and winter at a comparatively high figure.

The effect of the nitrate of sodium on Plot 9 will be best noticed in this place, as, like the ammonium-salts on the plots just considered, it is applied to the land in the spring. The quantity of nitrogen supplied in the nitrate of sodium is very nearly identical with that supplied in the form of ammonia to Plots 7, 10, 11, 12, 13, 14 and 15. As the whole of the nitrogen is already in the form of nitrate when applied to the land, the first drainage-waters from this plot are naturally much richer in nitrates than where ammonium-salts have been employed, for in the latter case a gradual process of nitrification must be gone through before the nitrogen can appear in the drainage. The mean of five April runnings from Plot 9 gives 52·2 of

nitrogen as nitrates per million of water, with a maximum of 68·9; this will be equivalent to an average loss of 11·8 lbs. of nitrogen, or 75·6 lbs. of nitrate of sodium per acre for each inch of drainage. These quantities much exceed those yielded by the corresponding plots receiving ammonium-salts. It is unfortunate for the present purpose that Plot 9 is not treated alike on its two halves, for while the "*a*" portion receives the mixed mineral manure, the "*b*" portion is unsupplied with ash-constituents. Half the plot is thus in a similar condition to Plot 7, and the other half to Plot 10 in the ammonia series, while the drainage-water is derived indifferently from both halves. The results yielded by the nitrate of sodium plot are, however, so distinct that we are left in little doubt as to its influence on the drainage-water. Although the largest wheat-crop in the field is yielded on an average by the half-plot 9 *a*, and consequently there must be on this half a large quantity of nitrogen taken up by the growing plant, the drainage-water contains, in nearly every recent season, more nitrate than that from Plot 10, where, as we have just seen, the waste of nitrogen reaches an extreme point. It appears, therefore, quite certain that when nitrate of sodium is applied to the Rothamsted soil a larger proportion of the nitrogen will appear in the drainage-water than when the same quantity of nitrogen is applied in the form of ammonium-salts.

We turn next to the plots receiving nitrogenous manures in autumn, and first of Plot 15, which receives the same quantity of ammonium-salts as Plots 7, 10, 11, 12, 13, and 14, but with the difference that these salts are applied in October instead of in March. There being no active growth of the wheat-plant during the winter months, the nitrates produced from the ammonia on this plot remain unconsumed, and in the absence of much rain will accumulate in the soil. The drainage-waters from this plot thus generally reach a greater richness in nitrates than is the case with any other plot in the field. The nitrogen as nitrates in the water usually attains 60–70 per million as its maximum in the course of the winter, and has in one case reached 83·2. The nitrates in the soil being exposed to loss by drainage for five or six months before the active growth of the wheat-crop commences, a very great loss of nitrogen will ensue whenever the winter is wet and drainage abundant, as has been the case in two out of the three winters during the period under consideration. With wet winter seasons the crop grown on Plot 15 is usually much smaller than that on Plot 7, where the ammonia is applied in spring. The comparative crops obtained in various years by autumn and spring applications of ammonium-salts have been already given in an earlier paper; see "Our Climate and Our Wheat Crops" in this 'Journal,' 1880, p. 205.

The Rape-cake (Plot 19) and farmyard-manure (Plot 2) are both applied to the land in the autumn; in each case the drainage-waters are richest in nitrates in the winter. Nitrification, however, proceeds far more slowly with these organic manures than in the case of ammonium-salts, the amount of nitrates lost by drainage even in a wet winter is thus much less considerable. The rape-cake yields more nitric acid to the drainage-water than the farmyard-manure, and, when opportunity is given for accumulation, the amount of nitric acid may become very considerable, as in the case of the drainage-waters of February 16 and 17, 1880, when the nitrogen as nitric acid amounted to 33·0 per million for Plot 19. This considerable production of nitric acid from rape-cake is a proof, if one were needed, that the nitric acid in soil is not produced, as is sometimes asserted, solely from animal matter or ammonium-salts.

TABLE XLVIII.—NITROGEN as NITRATES in DRAINAGE-WATERS from BROADBALK FIELD at different SEASONS of the Year, AVERAGE of THREE YEARS (November 1878–October 1881).

Plot.	Nitrogen as Nitrates per Million of Drainage-Water.					Nitrogen per Acre per inch of Drainage.
	Spring Sowing to end of May.	June to Harvest.	Harvest to Autumn Sowing.	Autumn Sowing to Spring Sowing.	Whole Year.	Whole Year.
						lbs.
2	3·6	1·4	6·0	9·5	7·5	1·70
3&4	3·0	0·1	4·8	5·0	3·9	0·88
5	2·9	0·2	4·8	5·5	4·2	0·95
6	14·7	0·7	6·0	5·4	5·4	1·22
7	27·1	1·4	7·3	5·4	6·8	1·54
8	28·2	4·0	13·5	7·5	9·3	2·10
9	50·4	9 1	15·0	7·8	12·5	2·83
10	31·6	11·4	12·7	6·9	10·7	2·42
11	25·8	5·8	9·0	7·7	9·0	2·04
12	22·6	3·7	8·0	7·1	7·9	1·79
13	26·4	1·9	7·3	6·7	7·6	1·72
14	31·6	3·4	8·1	7·5	8·5	1·92
15	6·7	2·9	7·5	28·1	19·3	4·37
16	3·3	0·1	5·3	5·6	4·5	1·02
17 & {Amm.	29·7	1·8	6·6	5·5	7·1	1·61
18 {Min.	1·5	0·3	5·6	5·5	4·3	0·97
19	3·7	0·5	7·7	14·0	10·4	2·35

In Table XLVIII. is given a summary view of the nitrogen as nitric acid present in the drainage-waters of the various plots at different seasons of the year, based on the analyses made at Rothamsted during the last three years. The figures are of great interest; they should not, however, be taken as more than indications of the general truth. This is especially to be

remembered in dealing with the figures given for the autumn period. The analyses made of autumn waters refer mostly to waters following *dry* summers, not that summer which furnished the analyses of summer waters. Although, therefore, it is quite true that the amount of nitrates rises in autumn in all cases where they have been much reduced in summer, the increase will not be so great in the case of many of the plots as would appear from the figures given for summer and autumn in the Table. In a side column of the Table is given the quantity of nitrogen in lbs. per acre removed on an average per inch of drainage-water. In the three years in question the average drainage shown by the 60-inch drain-gauge amounted to 17·72 inches per annum.

The richness of the spring waters (in wet seasons), where ammonium-salts or nitrate were applied; the characteristic differences of the summer waters, depending on the action of the crop under different conditions as to the supplies of nitrogen and ash constituents; the increase of nitric acid in autumn on plots where nitrates had been reduced in summer; the generally similar character of the winter waters, the result of exhaustion by crop and drainage; and lastly, the considerable losses attending the autumn sowing of nitrogenous manures when followed by a wet winter, are the principal facts which will be found illustrated in the above Table.

We have already seen (pp. 23, 34) that the composition of the waters from Plots 5–10 is not strictly comparable with that of the waters from Plots 11–15, the latter waters being, for some cause, imperfectly understood, somewhat more concentrated than the former. We may avoid this source of error if, instead of looking at the quantity of nitric acid in the different waters, we regard simply its relation to the chlorine; this is shown in Table XLIX.

TABLE XLIX.—PROPORTION of NITROGEN as NITRIC ACID to 100 of CHLORINE in DRAINAGE-WATERS from BROADBALK FIELD at different SEASONS of the Year: average of THREE YEARS.

Plot.	Ash constituents applied.	Spring.	Summer.	Autumn.	Winter.	Whole Year.
7	Phos. Acid, Potash, Magnesia, Soda ..	31·1	6·9	20·2	45·1	29·4
17 or 18	Ditto ditto	30·3	6·9	18·1	43·9	27·8
13	Phos. Acid, Potash ..	31·1	6·3	14·4	44·2	26·1
14	„ „ Magnesia	32·1	10·8	17·3	53·4	30·7
12	„ „ Soda ..	33·2	12·1	18·0	51·1	30·6
11	Phosphate alone	43·8	18·3	19·5	51·2	34·4
10	None	43·6	38·7	37·6	53·1	44·0

All the plots mentioned in this Table receive the same quantity both of nitrogen and chlorine, but with different supplies of ash constituents. Where the principal ash constituents required by the crop are supplied (Plots 7, 17 or 18, 13) there a large assimilation of nitrogen takes place during the summer months, and the proportion of nitrogen to chlorine in the drainage-water becomes very low. Where potash has never been applied (Plot 11), or not for many years (Plots 12, 14), a larger proportion of nitric acid escapes assimilation. Where neither phosphoric acid nor potash is applied (Plot 10), the proportion of nitric acid left untouched by the crop and removed in the drainage-water is much increased. In winter time the proportion of nitrogen to chlorine in the drainage-water is in all cases high, the chlorides of the manure having by this time been washed out of the soil to a considerable extent, while a new formation of nitric acid is continually in progress.

We must not leave the subject of the amount of nitrogen as nitrates present in the drainage-waters without referring to the quantities shown by Voelcker's and Frankland's early analyses (Table XLV.). The amount of nitrogen per million shown for the unmanured Plot 3 & 4 is identical with the average found for this plot in the later Rothamsted determinations (Table XLVII.); the amount found for Plot 5, receiving no nitrogenous manure, is also very similar to the later results; all the remaining determinations are, however, much higher than those obtained during the last three years. This difference is partly due to the extreme wetness of recent seasons, resulting in weak drainage-waters; but in the case of plots receiving ammonium-salts it is chiefly determined by the fact that, during the years to which the earlier analyses refer, the ammonium-salts were in every case applied to the land in autumn. The results obtained by Voelcker and Frankland for Plots 7, 10, 11, 12, 13, 14, 15, are thus, so far as time of sowing is concerned, comparable with those now yielded by Plot 15.

The greater loss of nitric acid in spring and summer drainage, where the ash constituents required by the crop were deficient, is equally shown by the earlier analyses (Tables XLVI. and XLVII.), as by our own later determinations.

3. The Quantity of Nitrogen lost by Drainage.

We have now discussed in considerable detail the very numerous results obtained relating to the composition of the drainage-waters collected from the differently manured plots in the experimental wheat-field. We have shown the influence of the amount and stage of the running, the description of the

manure, and the time at which it is sown, the period of the year, and the character of the seasons, on the composition of the waters.

Confining attention to the loss of nitrogen by drainage which has been indicated, it has been seen that its amount has been very directly connected with the amount supplied in the manure. The practical question obviously suggests itself—whether, in the case of the experimental wheat-field, in which known quantities of nitrogenous manure have been applied, and known quantities of nitrogen removed in the crops, for many years in succession, the facts at command are sufficient to enable us to estimate how much nitrogen has been lost by the drainage from the different plots?—and whether the whole of the nitrogen of the manure which has not been recovered in the increase of crop, may be accounted for by the ascertained loss by drainage?

It is obvious that, to be able to give an exact answer to this question, it is essential to know, not only the total amount of drainage which has passed from the land, and the amount of nitrogen it has carried with it, but also how much nitrogen has been supplied to the soil, or the crop, from the atmosphere by rain or condensation, and how much has been yielded to the crop, or to the drainage, by the soil itself?—or whether, on the other hand, some of the unrecovered amount is retained by the soil or subsoil, possibly to be slowly recovered in succeeding crops?

Unfortunately, we have no means of gauging the total amount of drainage passing from the land of the experimental wheat-field. We can only form some judgment of it from the quantities determined in the case of the 20-inch, 40-inch, and 60-inch soil-drain-gauges, the results obtained by which during between ten and eleven successive seasons have been fully described in Part II. of this Paper. It is assumed that the results of the 60-inch drain-gauge will probably afford the best basis for estimating the amount of drainage in the experimental wheat-field. It would seem probable that during the late autumn, the winter, and the early spring, the amount of drainage would not differ widely in the two cases; but that, during the active growth of the crop, and for some time afterwards, the loss would be less in the experimental wheat-field than through the drain-gauge, owing to the drying of the soil under the influence of the growing crop.

Using such data as we possess, we propose to give, in the first place, an estimate of the quantity of nitrogen lost by drainage from most of the plots of the experimental wheat-field, during two recent years, for which we have analyses of every running from the drain-pipes. We shall afterwards attempt to estimate the loss for a much longer period in the history of the experimental field.

In Table L. (p. 46) is given the estimated loss per acre of nitrogen as nitrates in the drainage-water from the selected plots, for the two years commencing from the date of the spring sowing of the manures in 1879, to the corresponding period in 1881. Each year is divided into two periods, namely, from spring sowing to harvest, and from harvest to the next spring sowing. For each separate period, and for the whole period, the estimated total loss is given; also the excess of loss from each plot receiving nitrogen in manure, over that from Plot 5 receiving mineral manure without nitrogen. The quantity of drainage for each period is assumed to be the same as that through the 60-inch soil-drain-gauge during the same period; and the so assumed amounts of drainage are given at the bottom of the Table. The quantity of nitrogen as nitrates in the estimated drainage-water for each plot is reckoned according to the mean of all the analyses of the waters collected from the plot during periods from spring sowing to the end of May, from June 1 to harvest, from harvest to autumn sowing, and from autumn sowing to spring sowing. For some periods, however, for which there was drainage through the 60-inch soil-gauge, but none from the pipes in the experimental field, an estimate of the probable composition of the drainage shown by the drain-gauge has been made. Were it not that there is not always drainage from the drain-pipes when there is through the drain-gauge, it would be more correct to reckon each separate analysis on the amount of drainage from the 60-inch gauge. For this and other reasons, as will be seen further on, the estimates must be taken as only approximations to the truth. The nitrate of sodium on Plot 9, and the ammonium-salts (excepting on Plot 15), were sown, in 1879 on March 13, and in 1880 on March 9. On Plot 15, the ammonium-salts were applied on October 15, 1878; October 22, 1879; and October 25, 1880.

Before referring to the estimates of the loss of nitrogen by drainage which the Table records, attention should be called to the fact that the two seasons in question were very exceptional in two ways, and do not therefore represent the average conditions of the experimental field. In the first place, in twenty-five of the first twenty-six of the thirty years during which (with a few special exceptions) the same description and amount of manure has been applied year after year on the same plot, the ammonium-salts were sown in the autumn; but during the last four years, which include the two under consideration, they were (excepting on Plot 15) not applied until the spring. This fact would be supposed to tend to reduce the loss of nitrogen by drainage. Again, although the amounts of rain and drainage were very differently distributed in the two seasons, the

TABLE L.—ESTIMATED LOSS of NITROGEN, as NITRATES, in the DRAINAGE-WATERS from the EXPERIMENTAL WHEAT FIELD.

TWO YEARS. QUANTITIES IN LBS. PER ACRE.

PLOTS.		1879–80.						1880–81.						Average per Annum. 2 Years.	
		Total estimated Loss.			Loss + or − Plot 5.			Total estimated Loss.			Loss + or − Plot 5.				
		Spring Sowing to Harvest.	Harvest to next Spring Sowing.	12 Months Spring Sowing to Spring Sowing	Spring Sowing to Harvest.	Harvest to next Spring Sowing.	12 Months Spring Sowing to Spring Sowing.	Spring Sowing to Harvest.	Harvest to next Spring Sowing.	12 Months Spring Sowing to Spring Sowing.	Spring Sowing to Harvest.	Harvest to next Spring Sowing	12 Months Spring Sowing to Spring Sowing.	Total.	+ or − Plot 5.
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
3&4	Unmanured, continuously	1·74	10·82	12·56	0·18	− 2·50	− 2·32	0·58	17·13	17·71	− 0·16	− 0·60	− 0·76	14·94	− 1·74
5	Mixed Mineral Manure	1·56	13·32	14·88	..	..	..	0·74	17·73	18·47	..	..	..	16·68	..
6	Mixed Min. Man. and 200 lbs. Ammonium-salts ..	10·12	12·56	22·68	8·56	− 0·76	7·80	2·25	19·81	22·06	1·51	2·08	3·59	22·37	5·69
7	Mixed Min. Man. and 400 lbs. Ammonium-salts ..	18·31	12·63	30·94	16·75	− 0·69	16·06	4·29	21·38	25·67	3·55	3·65	7·20	28·31	11·63
8	Mixed Min. Man. and 600 lbs. Ammonium-salts ..	24·95	17·55	42·50	23·39	4·23	27·62	8·70	33·81	42·51	7·96	16·08	24·01	42·50	25·82
9*a* 9*b*	Mixed Min. Man. and 550 lbs. Nitrate Sodium .. 550 lbs. Nitrate Sodium alone	44·99	15·61	60·60	43·43	2·29	45·72	15·03	40·99	56·02	14·29	23·26	37·55	58·31	41·63
10	400 lbs. Ammonium-salts alone	42·87	14·35	57·22	41·31	1·03	42·34	7·38	35·24	42·62	6·64	17·51	24·15	49·92	33·24
11	400 lbs. Ammonium-salts and Superphosphate ..	28·29	17·75	46·04	26·73	4·43	31·16	3·37	29·57	32·94	2·63	11·84	14·47	39·49	22·81
12	400 lbs. Amm.-salts, Superphosph. and Sulph. Sodium	21·25	17·51	38·77	19·67	4·22	23·89	3·32	27·17	30·49	2·58	9·44	12·02	34·63	17·95
13	400 lbs. Amm.-salts, Superphosph. and Sulph. Potass.	19·01	16·43	35·44	17·45	3·11	20·56	3·68	25·33	29·01	2·94	7·60	10·51	32·23	15·55
14	400 lbs. Amm.-salts, Superphosph. and Sulph. Mag.	25·99	16·85	42·84	24·43	3·53	27·96	4·25	25·94	30·19	3·51	8·21	11·72	36·51	19·83
15*	400 lbs. Amm.-salts, and Mixed Mineral Manure ..	9·62	59·92	69·54	8·06	46·60	54·66	3·40	74·94	78·34	2·66	57·21	59·87	73·94	57·26
16	Unmanured, 1865 and since	1·61	12·63	14·24	0·05	− 0·69	− 0·64	0·76	17·86	18·62	0·02	0·13	0·15	16·43	− 0·25

ESTIMATED DRAINAGE FOR THE SAME PERIODS.

	1879–80						1880–81						Average	
Drainage through the 60-inch Soil-Drain-gauge—inches ..	11·1	4·7	15·8	..	..	..	1·8	18·8	20·6	..	..	..	18·2	..

* Ammonium-salts autumn sown.

quantities of both were, upon the whole, very exceptionally large. The mean annual rainfall of the two seasons was 34·8 inches, or nearly 6½ inches more than the average of the thirty years. The mean annual drainage through the 60-inch soil-drain-gauge was more than 18 inches, or more than 8 inches above the average of eleven years. These conditions would obviously, on the other hand, tend to excessive loss by drainage. There were, therefore, during the period selected, exceptional circumstances operating in opposite directions. Still, as illustrations of loss by drainage, the results given are extremely effective.

Referring to the record of the quantity of drainage passing through the 60-inch drain-gauge during each period, as given at the bottom of the Table, it will be seen that in the first season, 1879–80, there was a very large amount of drainage from spring sowing to harvest, that is during the active growth and ripening of the crop, and a comparatively small amount from the time of its removal to the commencement of active growth in the succeeding spring. Accordingly we have even a much greater loss of nitrogen by drainage during the active growth and ripening of the crop than during the six or seven months afterwards.

In the second season, 1880–1881, on the other hand, there was a very small amount of drainage during the growth and ripening of the crop, and a very excessive amount from the time of its removal to the commencement of growth in the following spring. Under these very different conditions the amounts of nitrogen lost by drainage within the two periods of the second season are very different from those of the first. There is now scarcely any loss from spring sowing to harvest, but very great loss from harvest to the next spring sowing.

It should be stated, however, that as in the dry winter of 1879–80 the drains only ran in February, and then gave water rich in nitrates, the result of accumulation, the estimates for that period, calculated on the composition of those waters alone, are doubtless above the truth. The losses during the very wet winter of 1880–81 are, on the other hand, probably underestimated.

Comparing the one whole season with the other there is not a very great difference in the amount of total loss in the two cases; but it is, upon the whole, greater in the first year, with the excessive drainage soon after the application of the nitrogenous manures, notwithstanding the counteracting effect of the growth of the crop during that period, both upon the amount of drainage, and upon the amount of nitrogen as nitrates the soil would contain.

The great loss of nitrogen as nitrates from the soil itself, in wet seasons, is strikingly shown in the results for Plot 3&4 con-

tinuously unmanured, Plot 5 receiving annually for nearly thirty years mixed mineral manure alone, but mineral and nitrogenous manure previously, and Plot 16 unmanured for sixteen or seventeen years, after excess of ammonium-salts with mixed mineral manure, previously. During the first twelve months the loss by drainage from these three plots was $12\frac{1}{2}$, nearly 15, and $14\frac{1}{4}$ lbs. of nitrogen per acre; and during the second twelve months it was $17\frac{3}{4}$, $18\frac{1}{2}$, and $18\frac{1}{2}$ lbs. per acre. Further, notwithstanding the comparative dryness of the autumn and winter period in the first season, and the very excessive drainage during the same period of the second season, nearly the whole of the loss is, in both cases, after the removal of the crop; that is, during the long period of the year in which land under cereal culture is practically bare of vegetation. It may be here remarked, that the close approximation of the quantities estimated to be lost on Plots 5 and 16, with very similar manurial history, though the one is at one side and the other at the other side of the field, affords some evidence of the comparative character of the results in the different parts of the field.

The loss of nitrogen estimated to be derived from that of the nitrogenous manures applied, is best studied by reference to the columns in the Table which show the excess in the drainage from the plots receiving nitrogenous manure over the amount from Plot 5 with mineral without nitrogenous manure.

Comparing Plots 5, 6, 7 and 8, each receiving the same mixed mineral manure, but Plot 5 with no ammonium-salts, Plot 6 with 200 lbs., Plot 7 with 400 lbs., and Plot 8 with 600 lbs. of ammonium-salts per acre per annum, there were, during the very wet period from spring sowing to harvest in 1879, losses of 8·56, 16·75, and 23·39 lbs. of nitrogen more from the three ammonium plots than from Plot 5; that is, quantities increasing closely in proportion to the increased supply by manure. Then again, taking the series of plots with the same amount of ammonium-salts, but with different mineral manures for many years in succession, and yielding, accordingly, very different amounts of crop, there are very variable amounts of loss of nitrogen, ranging from 41·31 lbs. per acre with ammonium-salts alone (Plot 10), to only 16·75 lbs. with the same amount of ammonium-salts and the most complete mineral manure (Plot 7). The loss on the other plots of the series gradually increases with the defect of the mineral manure and the coincident defect of growth. Thus, with superphosphate of lime and potassium-salts (Plot 13) it is 17·45 lbs., or but little more than with the mixed mineral manure; with superphosphate and soda, with a residue of potash from previous applications (Plot 12), it is 19·67 lbs.; with superphosphate and magnesia, and some residue of potash

(Plot 14), it is 24·43 lbs.; with superphosphate of lime alone (Plot 11), 26·73 lbs.; and lastly, with ammonium-salts alone (Plot 10), 41·31 lbs. To such a great extent was the unused nitrogen of the manure washed out during the growth of the miserable crop on Plot 10, with the ammonium-salts alone, that there was only 1·03 lb. of that supplied accounted for in the drainage of the whole succeeding period from harvest to the next spring sowing. With this exception, the loss during the period subsequent to the removal of the crops, though very much less in actual amount, varies on the different plots much in the same order as previously.

In the dry period of growth of 1880, on the other hand, the estimated losses from the manure were comparatively small. They were as before, the greater, the greater the supply of ammonium-salts: and greater with an equal supply of them used alone than when in conjunction with mineral manure. With the excessive rain and drainage during the period of more than six months subsequent to harvest, the losses were much greater than during the period of growth; and on the plots with the same amount of ammonium-salts, but different mineral manures, the losses varied exactly in the same order as during the wet period of growth of 1879. Thus, they were on Plot 7, with the ammonium-salts and the complete mineral manure, 3·65 lbs.; on the intermediate plots, 7·60, 8·21, 9·44, 11·84; and on Plot 10, with the ammonium-salts alone, 17·51 lbs.

Finally, the average amounts of loss per acre per annum (over the two years) estimated to be due to the nitrogen of the manure, as shown in the last column of the Table, are with the same mineral manure and increasing amounts of ammonium-salts, 5·69, 11·63, and 25·82 lbs. accounted for in the drainage. And, with the same amount of ammonium-salts and different mineral manures, the average losses are—from Plot 7, with the complete mineral manure, 11·63 lbs.; from the intermediate plots, 15·55, 17·95, 19·83, 22·81; and with the ammonium-salts alone, 33·24 lbs.

Large as are these losses with the ammonium-salts spring sown, the loss is very much greater where, as on Plot 15, they were sown in the autumn, though with the same complete mineral manure as on Plot 7. The loss from the autumn-sown plot had been very great during the winter of 1878–9, and it was accordingly very much less than from the spring-sown plots during the period of growth and ripening of 1879. Receiving the ammonium-salts again in October 1879, the loss estimated to be due to the manure was 46·6 lbs. from the date of the preceding harvest to the time of spring sowing in 1880. This is more than ten times as much as during the same period from

any of the plots which had not received ammonium-salts since the preceding spring; but it has been explained (p. 47) that all the estimates of loss for this period are probably too high. After this great loss during the winter, there was very little further loss from Plot 15 during the succeeding period of growth. But again receiving the ammonium-salts in October 1880, there was, from the date of the preceding harvest to the commencement of active growth in the following spring, a loss of 57·2 lbs. estimated to be due to the manure, or nearly sixteen times as much as from the spring-sown Plot 7 during the same period.

We turn now to the comparison of the results on Plots 7 and 9. Plot 7 received annually a given amount of nitrogen as ammonium-salts, and Plot 9 approximately the same amount as nitrate of sodium. Plot 7 received also the complete mixed mineral manure; but only one half, or one land, of Plot 9 (9*a*) received the mineral manure, the other half (9*b*) receiving the nitrate of sodium alone. On both plots the nitrogenous manure was applied in the spring.

During the very wet period from spring sowing to harvest 1879, there was an estimated loss from the ammonium-salts of 16·75 lbs. of nitrogen per acre, but from the nitrate of sodium of 43·43 lbs. There was little or no estimated loss from the manure of either plot from harvest to the next spring sowing. From spring sowing to harvest (1880), with very little drainage, there was a loss of 3·55 lbs. from the ammonium-salts, and of 14·29 lbs. from the nitrate; and during the very wet period from harvest to the next spring sowing (1881), there was a loss of 3·65 lbs. from the ammonium-salts, and of 23·26 lbs. from the nitrate of sodium; or, over the whole twelve months, of 7·2 lbs. from the ammonium-salts, and of 37·55 lbs. from the nitrate.

There was thus a very much greater loss of nitrogen by drainage when a given amount was supplied as nitrate of sodium than when as ammonium-salts. But the loss from the nitrate was probably much greater than it would have been in consequence of one of the two lands receiving no mineral manure, and the growth on it being accordingly very much less. Still, the loss will generally be greater from a given amount of nitrate than from a corresponding quantity of ammonium-salts, when the amount of nitrogen supplied is much in excess of that which can be taken up by the crop, or when the season is wet.

Table LI. shows for the two seasons, the average annual quantities, in lbs., of nitrogen supplied in manure, obtained in the crops, estimated in the drainage, and in the crop and drainage together; also the amounts unaccounted for in either crop or drainage.

TABLE LI.—NITROGEN supplied in MANURE, recovered in the CROP, and in the DRAINAGE, and unaccounted for in either CROP or DRAINAGE, in the EXPERIMENTAL WHEAT-FIELD.

TWO YEARS. QUANTITIES IN LBS. PER ACRE.

PLOTS.		Nitrogen per Acre per Annum.				
		In Manure.	In Crop.	In Drainage.	In Crop and Drainage.	Un-accounted for.
		lbs.	lbs.	lbs.	lbs.	lbs.
3&4	Unmanured continuously ..	0	12	15	27	(+ 27)
5	Mixed Mineral Manure ..	0	16	17	33	(+ 33)
6	Mixed Min. Man. and 200 lbs. Ammonium-salts	44	27	22	49	(+ 5)
7	Mixed Min. Man. and 400 lbs. Ammonium-salts	88	40	28	68	20
8	Mixed Min. Man. and 600 lbs. Ammonium-salts	132	49	43	92	40
9	Mixed Min. Man. (on half) and 550 lbs. Nitrate Sodium	86	32	58	90	(+ 4)
10	400 lbs. Amm.-salts, alone ..	88	14	50	64	24
11	400 lbs. Amm.-salts and Superphosphate	88	29	39	68	20
12	400 lbs. Amm.-salts, Superphos., and Sulph. Sodium	88	32	35	67	21
13	400 lbs. Amm.-salts, Superphos., and Sulph. Potass ..	88	38	32	70	18
14	400 lbs. Amm.-salts, Superphos. and Sulph. Magnesium	88	37	37	74	14
15	400 lbs. Amm.-salts, and Mixed Mineral Manure ..	88	32	74	106	(+ 18)
16	Unmanured, 1865 and since	0	14	16	30	(+ 30)

In reference to the quantities of nitrogen supplied by manure, it is assumed that the 400 lbs. ammonium-salts supplied 88 lbs.; and they may have supplied nearer 90 lbs. Formerly we assumed this quantity to contain only 82 lbs.; but of late years ammonium-salts have occurred in commerce in a state of greater purity. The amount of nitrogen contributed by manure obviously by no means represents the total quantity annually available. There will be about 2 lbs. annually supplied in the seed; and there is a considerable quantity, of which we shall endeavour to form some estimate further on, annually available from the atmosphere by rain and condensation, and from the stores in the soil itself. Our present purpose is, however, only to call attention to the relation of the amount of nitrogen in the crop and drainage to that in the manure.

It will be seen that in only two cases of spring sowing of the nitrogenous manures, Plot 6 with the smallest quantity of ammonium-salts, and Plot 9 with nitrate of sodium, did the

total amount in crop and drainage together, exceed the supply by manure alone.

Referring to the results a little more in detail, Plots 6, 7, and 8, with the mixed mineral manure, and 200 lbs., 400 lbs., and 600 lbs. of ammonium-salts, respectively, yielded in the crops 27 lbs., 40 lbs., and 49 lbs., and in the drainage 22 lbs., 28 lbs., and 43 lbs., of nitrogen per acre per annum. There is, therefore, notwithstanding the increased amount in the crop, the greater estimated loss by drainage the greater the excess in the manure. Still, much more remains unaccounted for in either crop or drainage the greater the amount supplied.

Compared with these results from spring sowing, we have in the case of Plot 15, with autumn sowing, considerably more nitrogen in the crop and drainage together than was supplied in the manure. In fact, with 88 lbs. supplied in the manure, it is estimated that there were 74 lbs. in the drainage alone; whilst only 28 lbs. were so accounted for on Plot 7 with the same amount of ammonium-salts not applied until the spring. Taking the amounts in crop and drainage together, there was with autumn sowing about one-fifth more, but with spring sowing about one-fifth less, accounted for than was supplied in the manure.

There was then, in these two seasons, much less of the nitrogen of the manure accounted for in crop and drainage with spring sowing than with autumn sowing; and the unaccounted-for amount was the greater, the greater the excess in the manure. We shall have to refer to this point again further on.

Such are the results of two years' direct experiment, for which we have the analysis of the drainage-waters of every running from the pipes. It has been seen that, reckoning only the nitrogen supplied in the manure against the amounts in the crop and drainage, a considerable quantity of that so supplied remains unaccounted for. We shall now endeavour to make an estimate of the average loss by drainage on the different plots, over the thirty years—1851–2 to 1880–1—during which (with a few special exceptions) the same description and amount of manure has been applied year after year on the same plot. Excepting for the crop of the second year, 1853, when the previous autumn and winter were extremely wet, the ammonium-salts were, until the last four years of the thirty, applied in the autumn; but during those four years they have not been applied until the spring. Plot 15 is the only exception to this; for the five crops—1873 to 1877 inclusive—it received the ammonium-salts in the spring; but for the last four crops—1878–1881—when all the other plots received them in the spring, Plot 15 received them in the autumn. To Plot 9, the nitrate of sodium has always been applied in the spring.

In default of more accurate knowledge of the amount of drainage from the land of the experimental wheat-field, the drainage through the 60-inch soil-drain-gauge is in the following, as in the preceding estimates, taken as the basis of calculation. We have, however, the record of this only for the last eleven years of the thirty. For the preceding seventeen (as well as for the last eleven) years we have the record of the rainfall at Rothamsted, and for the first two years we adopt the amounts for a neighbouring station (Nash Mills); so that thus we have the rainfall for the first nineteen years. Then, each year being divided into the characteristic periods—from autumn sowing to spring sowing, from spring sowing to the end of May, from June 1 to harvest, and from harvest to autumn sowing again—the rainfall for each such period for each of the first nineteen years is taken; and the drainage of each period is assumed to be the same as with the nearest corresponding rainfall for like periods during the eleven years for which the record of both rainfall and drainage is available.

As to the composition of the drainage, the amounts of which are so estimated, we have for the twenty-five years during which the ammonium-salts were sown in the autumn, only the few determinations by Dr. Voelcker and Dr. Frankland, on samples collected in only a few of the twenty-five years. Upon these we have to rely in estimating the composition of the drainage of two of the most important of the four periods of the year into which each of the twenty-five years is divided; and for the other periods, less influenced by the time of sowing the manure, or by growth, average figures are adopted from the more recent determinations. For the second year of the thirty, when the ammonium-salts were spring-sown, and for the first of the last four years of spring sowing, the composition of the drainage of the different periods of the season is calculated according to the average results for the corresponding periods of the last, or succeeding three years. For these three years themselves, an almost complete series of actual determinations is available.

The following Table (LII.) gives the so estimated losses of nitrogen by drainage, in lbs. per acre per annum, for each of the different series of years. It also gives the average for the whole thirty years; and for comparison the mean for the two years from the time of spring sowing in 1879 to the same period in 1881. In the last two columns are given, for the thirty years, and for the two years, the estimated losses from each plot receiving nitrogenous manure over Plot 5 with mineral manure alone.

TABLE LII.—ESTIMATED LOSS of NITROGEN, as NITRATES, in the collected DRAINAGE-WATERS from the different PLOTS in the EXPERIMENTAL WHEAT FIELD.

THIRTY YEARS, QUANTITIES IN LBS. PER ACRE.

PLOTS.	19 years, 1851–2, to 1869–70.	7 years, 1870–1, to 1876–7.	1 year, 1877–8.	3 years, 1878–9. to 1880–1.	30 years, 1851–2, to 1880–1.	2 years, 1879–80, to 1880–1.	+ or – Plot 5. 30 years, 1851–2, to 1880–1.	+ or – Plot 5. 2 years, 1879–80, to 1880–1.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
3 & 4	9·1	11·1	11·8	15·9	10·3	15·2	– 1·7	– 1·5
5	10·6	13·2	13·6	17·3	12·0	16·7	..	..
6	17·3	22·7	20·9	20·7	19·0	22·4	+ 7·0	+ 5·7
7	28·9	38·9	31·6	25·8	31·0	28·3	+ 19·0	+ 11·6
8	39·9	53·2	40·5	34·3	42·5	42·5	+ 30·5	+ 25·8
9	32·5	35·6	60·3	48·0	35·7	58·3	+ 23·7	+ 41·6
10	40·4	49·4	48·2	44·8	43·2	49·9	+ 31·2	+ 33·2
11	38·1	49·6	38·5	35·2	40·5	39·5	+ 28·5	+ 22·8
12	34·3	45·7	34·2	30·1	36·5	34·6	+ 24·5	+ 17·9
13	35·4	48·2	35·9	27·7	37·6	32·2	+ 25·6	+ 15·5
14	36·9	49·4	42·0	32·1	39·5	36·5	+ 27·5	+ 19·8
15	34·3	*23·3	58·9	63·5	35·5	74·0	+ 23·5	+ 57·3
16	11.9	14·7	14·8	16·6	13·1	16·4	+ 1·1	– 0·3

* Five years spring-sown.

With regard to these estimates for different series of years, we will only call attention to the fact that they differ from one another in the direction that it would be expected they would do, having regard to the difference in the characters of the seasons, to the average character of the crops accordingly, and to the time of year at which the ammonium-salts were sown.

The next Table (LIII.) shows for the whole thirty years: in the upper division, the estimated amounts of nitrogen removed in the crops and lost in the collected drainage, also the amount of that supplied which is unaccounted for in either crop or drainage; in the middle division, the excess of the amounts on the plots with nitrogenous manure over those on Plot 5 without it, and the amounts of that supplied in manure which are not accounted for in the increase in crop and drainage together. Finally, there is given the percentage on the amounts supplied in manure, recovered in the *increase* in crop, in the *increase* in drainage, and unaccounted for in either.

The first four columns show the results for Plot 5 with the mineral manure alone, Plot 6 with the mineral manure and 200 lbs. ammonium-salts, Plot 7 with the mineral manure and 400 lbs., and Plot 8 with the mineral manure and 600 lbs. ammonium-salts. It is seen that the nitrogen in the crop

TABLE LIII.—Estimated NITROGEN supplied in MANURE, recovered in the CROPS and in the collected DRAINAGE, and unaccounted for in either CROP or DRAINAGE, in the EXPERIMENTAL WHEAT FIELD.

THIRTY YEARS, 1851-2 to 1880-1, inclusive.

	Mixed Mineral Manure.				86 lbs. Nitrogen per Acre per Annum in Manure.						
		Ammonium-salts equal to—			As Ammonium-salts.						As Nitrate.
	Without Ammonium-salts. Plot 5.	43 lbs. Nitrogen. Plot 6.	86 lbs. Nitrogen. Plot 7.	129 lbs. Nitrogen. Plot 8.	Without Mineral Manure. Plot 10.	Superphosphate. Plot 11.	Superphosphate and Soda. Plot 12.	Superphosphate and Potass. Plot 13.	Superphosphate and Magnesia. Plot 14.	Mixed Mineral Manure. Plot 7.	Mixed Mineral Manure (on half). Plot 9.
TOTAL.											
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Nitrogen In Crop	20·3	32·8	46·2	57·4	32·7	38·0	42·5	43·7	44·4	46·2	46·3
Nitrogen In Drainage	12·0	19·0	31·0	42·4	43·2	40·5	36·5	37·6	39·5	31·0	35·7
Total	32·3	51·8	77·2	99·8	75·9	78·5	79·0	81·3	83·9	77·2	82·5
Unaccounted for ..	..	+ 8·8	8·8	29·2	10·1	7·5	7·0	4·7	2·1	8·8	3·5
EXCESS over PLOT 5.											
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Nitrogen In Crop	..	12·5	25·9	37·1	12·4	17·7	22·2	23·4	24·1	25·9	26·5
Nitrogen In Drainage ..	..	7·0	19·0	30·4	31·2	28·5	24·5	25·6	27·5	19·0	23·7
Total	..	19·5	44·9	67·5	43·6	46·2	46·7	49·0	51·6	44·9	50·2
Unaccounted for ..	..	23·5	41·1	61·5	42·4	39·8	39·3	37·0	34·4	41·1	35·8
EXCESS over PLOT 5. Per Cent. (SUPPLIED by MANURE equal 100.)											
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Nitrogen In Crop	..	29·1	30·1	28·8	14·4	20·6	25·8	27·2	28·0	30·1	30·8
Nitrogen In Drainage ..	..	16·3	22·1	23·6	36·3	33·1	28·5	29·8	32·0	22·1	27·6
Total	..	45·4	52·2	52·4	50·7	53·7	54·3	57·0	60·0	52·2	58·4
Unaccounted for ..	..	54·6	47·8	47·6	49·3	46·3	45·7	43·0	40·0	47·8	41·6

increases considerably, and that in the drainage increases proportionally more, with each increase of nitrogen in the manure. But if the amounts in the produce and drainage without ammonium-salts (Plot 5) be deducted from those with ammonium-salts, there is, so reckoned, a very large and increasing amount of that supplied unaccounted for in either crop or drainage.

The next six columns of the Table show the amounts of nitrogen in the crop, and estimated in the drainage, on six plots, each receiving 86 lbs. of nitrogen annually as ammonium-salts, in one case without any mineral manure, and in the others with different descriptions of mineral manure, for the whole period of 30 years or more. The amount of nitrogen annually removed in the crop is 32·7 lbs. with the ammonium-salts alone, and gradually increases with the addition of the different mineral manures until it reaches 46·2 lbs. with the ammonium-salts and the most complete mineral manure. The estimated amount in the drainage, on the other hand, is the highest, 43·2 lbs., with the ammonium-salts alone, and the lowest with the ammonium-salts and the complete mineral manure, namely, 31·0 lbs. The amounts in the crop and drainage respectively, are indeed, in the two cases, to a great extent complementary. Thus, with the ammonium-salts alone, there are, in crop and drainage together, 75·9 lbs., made up of 32·7 lbs. in crop, and 43·2 lbs. in the drainage; and, with the ammonium-salts and mixed mineral manure, there are in crop and drainage 77·2 lbs., but made up of 46·2 lbs. in the crop, and of 31 lbs. in the drainage. The intermediate plots also show upon the whole the less in the drainage the more there is in the crop.

The general result is that with the same amount of ammonium-salts and the complete mineral manure, there is the maximum amount of nitrogen per acre in the crop and the minimum amount in the drainage; but with the ammonium-salts without mineral manure, there is the minimum amount in the crop and the maximum amount in the drainage. Again, with the six very different conditions as to mineral manure, there is upon the whole the less accounted for in crop and drainage together, the less the amount in the crop, and the greater the actual amount in the collected drainage. There is in fact, as before, though more in the drainage, more entirely unaccounted for the greater the excess over the demands of the crop; whilst, with the more favourable conditions of growth in regard to mineral supply, and the more nitrogen taken up in the crop, the total amount in crop and drainage the more nearly approximates to the amount annually supplied in manure. Plot 7 is some exception to this; but there is reason to believe

that the drainage results for that plot are somewhat too low, and perhaps those of Plot 14 rather too high. Indeed, the total amount in crop and drainage is less for Plot 7 with ammonium-salts (in most years sown in the autumn) and the mixed mineral manure, than for Plot 9 with nitrate of sodium (always sown in the spring) and the mixed mineral manure on one-half only of the plot. With these differences there is on Plot 9 even rather more recovered in the crop, and there is more also in the drainage.

Finally, in these estimates for the thirty years, with much better average seasons, and much more nitrogen recovered in the crops, but with mostly autumn sowing, and generally rather more nitrogen in the drainage from the ammonia-plots, there is considerably more accounted for in crop and drainage together, than over the two seasons of spring sowing, and excessive drainage. The estimated amounts in the drainage were, indeed, over the two years, greater, or about equal, with defective mineral supply and defective growth accordingly, but they were less under the more favourable conditions of growth than over the thirty years.

It will be seen that in the foregoing comparisons of the amounts of nitrogen in the total crop and drainage with the amounts supplied in manure, no account is taken of the small quantity (say 2 lbs. per acre per annum) supplied in the seed, and the very much larger quantity contributed by rain and condensation from the atmosphere, and by the soil itself; nor of how much, if any, is retained by the soil.

Assuming that the crop and drainage of the plots receiving nitrogen in manure have received the same amount from other sources as Plot 5 without such manure, the amounts in the crop and drainage respectively, of that plot, have been deducted from the amounts for the other plots, and the result is given in the middle division of the Table. The amounts so deducted are, for crop 20·3 lbs., for drainage 12 lbs., together 32·3 lbs. Reckoned in this way, a very large amount of the nitrogen supplied by manure appears unaccounted for in crop and drainage. The quantities so unaccounted for amount, as shown in the bottom line of the Table, to from 40 to 50 per cent. of the total amount supplied; and with 86 lbs. of nitrogen in manure they range from 34·4 lbs. to 42·4 lbs. per acre per annum. The figures further show that, with the best conditions of mineral manuring and of growth, 30·1 per cent., or less than one-third of the supplied nitrogen, is recovered in the *increase* of crop, and that 22·1 per cent. have appeared in the drainage. Compared with this result there is, with the 400 lbs. of ammonium-salts alone, only 14·4 per cent. reckoned to be recovered in the

increase of crop, and 36·3 per cent. found in the drainage. The results for the plots with the partial mineral manures are intermediate between these two extremes.

The next question is—whether there is any accumulation of the nitrogen of manure within the soil which may account for some or all of the large amount otherwise unaccounted for?

In 1865 careful samples of the soil were taken from eleven of the differently-manured plots in the Experimental Wheat-field. The samples were taken from eight places on each plot, and in each case to three depths of 9 inches, or in all to a depth of 27 inches: and the eight samples of the same depth were mixed together. In no case were less than three determinations of nitrogen made in these mixed samples, and in some four or more. The following Table (LIV.) shows the mean percentage of nitrogen in the dry mould (that is, excluding stones and moisture) in the mixed samples of the first 9 inches of depth for each of the eleven plots. It also shows the calculated amounts of nitrogen per acre (reckoning 2,300,000 lbs. of dry mould to the depth of 9 inches), and the amounts on the other plots more or less than on Plot 5.

TABLE LIV.—MEAN PERCENTAGE, and QUANTITY PER ACRE, of NITROGEN in the SURFACE SOIL (9 inches deep) of SELECTED PLOTS in the EXPERIMENTAL WHEAT FIELD.

SAMPLES COLLECTED OCTOBER 1865.

Plots.	Manures per Acre per Annum.	Nitrogen in Dry Mould. Per Cent.	Per Acre.	Per Acre, + or − Plot 5.
		Per cent.	lbs.	lbs.
2	14 tons Farm-yard Manure	0·1882	4329	+ 1755
3	Unmanured	0·1090	2507	− 67
5a	Mixed Mineral Manure	0·1119	2574	..
7a	Mixed Min. Manure and 400 lbs. Amm.-salts ..	0·1230	2829	+ 255
9a	Mixed Min. Man. and 550 lbs. Nitrate of Sodium	0·1232	2834	+ 260
10a	400 lbs. Amm.-salts, alone (1845 and since) ..	0·1108	2548	− 26
11a	400 lbs. Amm.-salts and Superphosphate ..	0·1171	2693	+ 119
12a	400 lbs. Amm.-salts, Superphos. and Sulph. Soda.	0·1208	2778	+ 204
13a	400 lbs. Am.-salts, Superphos. and Sulph. Potass.	0·1206	2774	+ 200
14a	400 lbs. Amm.-salts, Superphos. and Sulph. Mag.	0·1197	2753	+ 179
16a	800 lbs.* Amm.-salts and Mixed Min. Manure	0·1264	2907	+ 333

These determinations of nitrogen relate to the condition of the plots after all had been under experiment for 22 years in succession. The unmanured and the farmyard-manured plots had been subject to the same treatment from the commencement.

* To 1864 inclusive, but none in 1865, or since.

Each of the other plots had, respectively, received the same description, and with immaterial exceptions the same amount, of manure for the last 14 years of the 22, but had been somewhat differently manured during the first 8 years.

Confining attention for the present to the several artificially-manured plots, it is seen at a glance that, with the exception of Plot 10, with the ammonium-salts alone, all the plots receiving annually 400 lbs. of ammonium-salts show a higher percentage and actual amount of nitrogen in the surface-soil than Plot 5 with the mineral manure without ammonium-salts; and Plot 16, which, during the first 13 of the 14 years had received annually 800 lbs. of ammonium-salts, or twice as much as any of the others (but had since grown one crop without any ammonia) shows a higher amount still. Without claiming absolute accuracy for the figures, it cannot fail to be observed that the excess on the different plots over Plot 5, as given in the last column of the Table, is very closely in the order of the amounts of nitrogen in the crops, and almost the converse of the order of the amounts in the drainage, as shown in Table LIII. Thus, there are the highest amounts in the crop, and the highest amounts in the surface-soil, on Plots 7*a* and 9*a*, with the most complete mineral manure; and the estimated loss by drainage from those plots is the lowest. There are less amounts of nitrogen in the crops, less in the soil, and there is more estimated loss by drainage, on Plots 12, 13, and 14, with superphosphate, and either soda, potash, or magnesia. There is less still in the crop, less still in the soil, and more loss in the drainage, on Plot 11, with only superphosphate as mineral manure. Finally, there is the least in the crop, no excess in the soil, and the most in the drainage, of Plot 10, with the ammonium-salts alone.

The second and third 9 inches of soil also show in most cases some, but a variable amount of excess of nitrogen in the case of plots receiving nitrogenous manure; but it would lead to too long a discussion to consider the results in any detail. This must be reserved for a special Report on our very numerous determinations of nitrogen in soils.

It may be stated, however, that in the autumn of last year (1881) samples were again taken, to three depths of 9 inches each, or to a total depth of 27 inches, from 20 plots in the Experimental Wheat-field, and the determination of nitrogen in them is now in progress. With regard to the results, we can only now state the significant fact that, so far as the amount of nitrogen in the surface-soil is concerned, the relation of plot to plot is essentially accordant at the two periods. Thus, the determinations in 1865 were made after 14 years, and those of 1881 after

30 years of continuous experiment; the amount of nitrogen in the surface-soil of Plot 5 without ammonium-salt is lower in 1881 than in 1865; and the difference in the amount on the different ammonium plots, compared with Plot 5, is, in most cases, approximately, twice as great after the 30 as after the 14 years. The order of excess of nitrogen on the different plots is again, in 1881, almost parallel with that of the increased yield of nitrogen in the crops, and it is almost the converse to that of the amount estimated to be lost by drainage.

From these facts it is obviously to be concluded that the relative excess of nitrogen in the soil of the different plots receiving nitrogen in manure, is much more closely connected with the amount of growth, than with direct retention of the nitrogen of the manure. In other words, the difference is mainly due to the residue of the crops—to the stubble and roots, and perhaps to weeds.

Further, the excess on the ammonia plots compared with Plot 5, is much more due to the reduction in the nitrogen of Plot 5 than to any increase on the ammonia plots; for the percentage in these is very nearly the same at the two periods, being, as a rule, slightly higher in 1881 than in 1865 on the plots of the best growth, and slightly lower on those of deficient growth. The indication is, therefore, not that the ammonia-plots have gained in the degree which the excess in the amounts over Plot 5 would show; but only that the loss which the soil itself has sustained in all cases, has been more or less completely compensated by the retention of nitrogenous crop residue, which has taken place much in proportion to the amount of crop grown and removed.

It is obvious that we must suppose a certain amount of nitrogen has been supplied to the crop, or to the drainage, or to both, from the soil itself. Whether this amount is greater or less where there is a liberal supply of nitrogen by manure than where there is not, the data do not enable us to determine with any certainty. On this point it may be stated that, taking the average of the whole 30 years, the estimates show an annual yield of nitrogen on the unmanured plot of 18·6 lbs. in the crop, and 10·3 lbs. in the drainage, or in all 28·9 lbs. per acre per annum. In like manner Plot 5, receiving nitrogenous manure during the first 8 years, but mineral manure only during the last 30 years, has yielded 20·3 lbs. in the crop, and 12 lbs. in the drainage, or in all 32·3 lbs. per acre per annum. So far as can be estimated, it would appear that the soil of each of these two plots has on the average of 30 years lost about two-thirds of these amounts annually, to the depth of 27 inches. There would remain, therefore, about one-third—say 10 lbs.,

more or less—to be contributed by seed, and by rain and condensation from the atmosphere. Of this about 2 lbs. will be due to seed, leaving not much more to be otherwise accounted for than has been shown to be annually supplied in rain and the minor deposits from the atmosphere.

Assuming 32 lbs. of nitrogen to be annually contributed by seed, rain and condensation, and the soil, to the vegetation and the drainage of the plots receiving nitrogen in manure, there is, as has been shown, a considerable amount of the total nitrogen available, which is not accounted for in the crop and drainage. Deducting the amounts in crop and drainage of Plot 5 from those of the other plots, as in Table LIII., it was shown that with 86 lbs. of nitrogen supplied in 400 lbs. ammonium-salts, there remained from 34 to 42 lbs. unaccounted for in increase of crop and drainage. Or, if we add the 32 lbs. assumed to be available from other sources to the 86 from the ammonium-salts, we have 118 lbs. annually available from all sources; and, as we have under the most favourable conditions of mineral supply and growth only about 80 lbs. in total crop and collected drainage, there remain, on this mode of reckoning, about 38 lbs. of the 118 annually unaccounted for; and with excess of nitrogen in manure very much more.

As on these modes of reckoning, the same amount is assumed to be available from seed, atmosphere, and soil, as to Plot 5, it is clear that the amount in the soil of the different plots in excess of that on Plot 5, is to be reckoned as so much reduction of the amount otherwise unaccounted for. So far as can be judged from the results already at command, it would appear that, with 86 lbs. of nitrogen supplied in manure, and the more favourable conditions of mineral supply and growth, perhaps one-third of the deficiency will be accounted for in the soil. There would still remain, therefore, say 25 lbs., more or less, annually unaccounted for, and the amount will be the greater the more defective the conditions of growth, or the greater the excess in manure. The latter are, nevertheless, the conditions under which the collected drainage accounts for the greatest actual quantity.

Either then the amounts of nitrogen estimated to be lost by drainage are too low, or there is some other source of loss.

With regard to the first supposition, it is admitted that there is uncertainty in the estimates of the total amount of drainage passing from the land; that it is a question how far the composition of the drainage collected from the pipes represents that of the total drainage; and that at any rate the determinations of nitric acid in the drainage-waters are but few, indeed far too few, for the long series of years during which the nitrogenous manures were sown in the autumn. On this point it may be

observed that in the case of the two years of unusually frequent drainage, and when every flow from the pipes was analysed, the amounts of nitrogen estimated to be lost by drainage from the autumn-sown Plot 15 was, together with the amount in the crop, nearly sufficient to account for the whole estimated to be available within that period; and so far as can be judged, the accumulation of residue within the soil would fully make up the deficiency. It must be borne in mind, however, that that period was very circumscribed.

It is obvious that in the case of the Experimental Wheat-field, with not many feet of clay sub-soil, and chalk below, favouring natural drainage, there will be much drainage from the land when none flows from the pipes. In fact, none does flow from the pipes except under the influence of continuous or heavy rain. The character of the drainage collected from them will, therefore, depend very directly on the contents of the soil above their level. Now, reference to the details of the analyses shows that the drainage-waters contained rather less chlorine at the end than at the beginning of the two years for which the loss of nitrogen by nitrates in the collected drainage-waters has been estimated. It is concluded, therefore, that none of the chlorine which had been supplied by manure and rain within the period, still remained above the level of the drain-pipes. But when the quantity of chlorine in the collected drainage-waters is calculated in the same way as the loss of nitrates has been estimated, it is found that in most cases a considerable amount of the chlorine supplied, and not appropriated by the crop, remains unaccounted for. Further, comparing the results for Plots 6, 7, and 8, with increasing amounts of chlorine supplied in the manure, the quantity unaccounted for is the greater, the greater the amount supplied. Thus, in the case of the chlorine, which is supplied in a condition at once highly soluble and diffusible, and the distribution of which will be less influenced by vegetation than will that of the nitrates, there is a considerable amount unaccounted for in the crop and the collected drainage, and there is evidence indicating that it does not remain above the level of the drain-pipes. The conclusion is that it has passed downwards by diffusion, and by drainage other than through the pipes. Calculation leads to the conclusion that nitrates have disappeared in the same way.

In the case of autumn sowing, the manure is on the ground four or five months before the commencement of vegetation, and during a period when there will usually be much more frequent drainage from the pipes than subsequently, It is to be supposed that under such circumstances a larger proportion of the nitrates which are formed near the surface will get directly

into the pipes than under the average conditions with spring sowing; and so far as this is so, there will be less disappearance due to diffusion downwards and drainage other than through the drain-pipes. It would be expected, therefore, that the drainage collected after autumn sowing would, as a rule, more directly represent the supplies by manure than would that after spring sowing. After spring sowing, active vegetation commences, and the conditions of temperature and evaporation are less favourable for immediate and direct drainage through the pipes. Indeed, notwithstanding the conditions may be more favourable for return upwards by diffusion or capillary action, it is to be supposed that there will, upon the whole, be more gradual passage of nitrates downwards by diffusion, and by drainage other than through the pipes.

There is, in fact, no doubt that the estimates of loss of nitrogen by drainage, founded on the composition of the collected drainage-waters, are frequently too low, and it may be that the whole of the otherwise unaccounted-for amounts are to be thus explained.

On the other hand, it has long ago been shown by Reiset, Boussingault, Ville, and at Rothamsted, that free nitrogen is frequently evolved in the decomposition of nitrogenous organic substances; and in the case of the farmyard-manure plot, with its enormous accumulation of organic matter, and comparatively little ascertained loss by drainage, there is a very large amount of the estimated supplied nitrogen unaccounted for; and there can be little doubt that here there has been considerable evolution as free nitrogen. Of the artificially-manured plots it is those which receive the greatest excess of nitrogen in manure which retain the largest amount of vegetable *débris;* and this is a condition which, if sufficiently developed, is favourable for the evolution of free nitrogen; and so again, the greater unaccounted-for amount in the case of the highly-manured plots might in part be explained. But, independently of a possible loss by the evolution in the free state of the nitrogen of decomposing organic matter within the soil, it has to be considered whether there may not be a loss of free nitrogen by the reduction of nitric acid within the soil. Schlösing found such a destruction and evolution in experiments in which the access of gaseous oxygen was excluded, and the soil was saturated with moisture. He concluded that the combustion of organic matter in the soil had taken place at the cost of the oxygen of the nitrate. In Part II., vol. xvii. p. 332, of this paper, similar results are recorded. In a water-logged soil, destitute of free oxygen, nitrates were reduced by the organic matter of the soil, carbonic acid was evolved, and there was a considerable loss of nitric

acid accordingly. Attention was called to the fact of the possible loss of nitrates, and even of soil-nitrogen, which may thus occur in ill-drained soils in wet weather.

It will be obvious that in the case of the artificially-manured plots in the experimental wheat-field, the soil will be unusually poor in decomposing organic matter, and that, so far, the conditions may be supposed to be little favourable for the evolution of free nitrogen from that source. Nor will the conditions of absence of gaseous oxygen, and of saturation by water, which are favourable to the reduction of the nitrates, frequently prevail. Without, however, denying that each of these actions may take place occasionally, or in a limited degree, we are disposed to give more weight to the established fact that in our mode of experiment and calculation the loss of nitrogen by drainage is under-estimated, than that there is material loss in other ways.

In 1866, at the meeting of the British Association held at Nottingham, we discussed the results of the determinations of nitrogen in the samples of soil collected from the experimental wheat-field in 1865, in their bearing on the question of the amount of the nitrogen of manure which is unrecovered in the increase of crop. We concluded that although some remained in the soil, "a considerably larger proportion would remain entirely unaccounted for within the soil to the depth under examination than was there traceable, and the probability was, that at any rate some of this had passed off into the drains, and some into the lower strata of the soil." The investigations which have been described in this paper, and which were undertaken to settle this point, have fully justified the conclusions then drawn. Finally, there is not sufficient evidence to show that, under the conditions of the experiments in question, there would be any other source of considerable loss.

Thus, it has been shown, in the case of a field under continuous wheat cropping, and receiving nitrogenous manure in the form of ammonium-salts or nitrate of sodium, that there was, with autumn sowing, even under the most favourable conditions as to mineral manure, on the average of a long series of years not quite one-third of the supplied nitrogen recovered in the *increase* of crop; and there was much less with defective mineral supply. Nor, so far as can be judged, would the accumulations of residue within the soil raise the amount recovered to one-half of that supplied. There was, on the other hand, a very great loss by drainage, which was very much the greater the more unfavourable were the conditions of growth, and the greater the excess of nitrogen in the manure. In fact, under comparatively favourable conditions, the amount found in the drainage nearly, or quite,

equalled that recovered in the increase of crop, whilst in unfavourable conditions it considerably exceeded it. Further, there can be no doubt that the actual loss by drainage was greater than the reckonings showed. These results are of very great importance as illustrations of the loss which may occur under known conditions.

The average conditions of practical agriculture are, however, not such as to lead to the loss by drainage of so large a proportion of the nitrogen supplied by manure. When ammoniacal manure or nitrate is used, it will generally be in less quantities than in the experimental wheat-field, in which so much loss by drainage has taken place; and such manures should only be applied when there is a growing crop ready to utilise them. But by far the greater part of the nitrogen supplied to the soil in ordinary agriculture is in farmyard-manure, or is directly deposited by animals. In either case a comparatively small proportion of the nitrogen becomes immediately soluble within the soil, and there will, therefore, be the less liability to loss by drainage. If the soil be heavily manured, and rich in organic matter, and especially if it be water-logged, and not freely aërated, there will be more danger of loss by the evolution of free nitrogen. Further, a considerable amount of the nitrogen of farmyard-manure will be ineffective, because it remains insoluble, and, so to speak, dormant within the soil. Again, in ordinary agriculture, a great variety of plants is grown in alternation one with another. The ground is thus covered with vegetation for longer, and at different, periods of the year, than in the case of a continuous cereal crop; whilst the various plants will have various root-ranges and habits of growth. Hence the nitrates brought into solution are in a much greater degree arrested by the growing crops. It has been shown in the case of the two wet seasons, the full details respecting which have been given, that during the autumn and winter, when there was no crop on the ground, there was even from the plots receiving no nitrogen in manure, a loss by drainage of from 15 to 20 lbs. of nitrogen per acre per annum; whilst from the plots highly manured with ammonium-salts or nitrate, the losses during the same period were very much greater. How great may be the loss by drainage with a bare fallow in wet seasons has been fully illustrated by the results relating to the drainage collected from the soil-drain-gauges, and the fact is here again strikingly brought to view.

SUMMARY.

Amount and Composition of Rainfall.

1. The rainfall at Rothamsted during 28 years, 1853–80, has varied from 18·56 inches in 1864 to 36·04 inches in 1879, the average being 28·30 inches.

2. Determinations of ammonia at Rothamsted in the rain of 1853–4 showed an average of 0·74 nitrogen per million; determinations by Way (1855 and 1856) 0·88 and 1·18 nitrogen per million. Frankland's determinations in 1869–70 showed 0·37 per million. Determinations made quite recently at Rothamsted confirm Frankland's results; the earlier figures are probably too high.

3. The total nitrogen supplied in the annual rainfall at Rothamsted is probably 4 to 5 lbs. per acre, excluding the condensation by the soil. The mean of continental estimates, including localities near towns, is 10·23 lbs. per acre.

4. The chlorine in Rothamsted rain has averaged 13·42 lbs., equal to 22·12 lbs. pure common salt per acre per annum. At Cirencester the amount is equal to 53·66 lbs. of salt.

Drainage-water from Land Unmanured and Uncropped.

5. The annual drainage during 10 years, 1870–1 to 1879–80, from three drain-gauges, of heavy loam with clay subsoil in natural condition of consolidation, 20, 40 and 60 inches deep, has varied from 4·97 to 25·86 inches, mean 13·49 inches, or 21·7, 60·5, and 43·4 per cent. of the rainfall.

6. The evaporation from the bare soil averaged 5·58 inches from October to March, and 11·97 inches from April to September, total 17·55 inches. The evaporation during the summer and whole year is a fairly constant quantity with great differences of rainfall.

7. The evaporation from a cropped soil is far more considerable, and very variable.

8. Nitrates are largely produced in soil by the action of a living ferment on the nitrogenous organic matter and ammonia; nitrification takes place chiefly in the upper layer of soil, and is greatly favoured by the presence of water, and by summer temperature. The waters from the drain-gauges are richest in nitrates in late summer and autumn, and poorest in spring.

9. The quantity of nitrogen as nitrates annually removed in the drainage-waters (October to September) has varied from 31·78 lbs. to 57·95 lbs. per acre; the average of four years,

1877–8 to 1880–1, is 41·81 lbs., equal to 268 lbs. of ordinary nitrate of sodium per acre.

10. The amount of chlorine in the drainage from the drain-gauges is approximately the same as in the rainfall.

11. The advantage of a bare fallow is largely due to the production of nitrates in the soil; in fields in bare fallow at Rothamsted 50 lbs. per acre of nitrogen as nitrates have been found at the end of summer in the first 20 inches. If followed by a wet winter, bare fallow must result in a serious loss of soil nitrogen.

Drainage-waters from Land Manured and Cropped with Wheat.

12. The drainage-water passing through a natural soil is of two kinds:—1. Surface-water passing downwards through open channels. 2. The discharge from the saturated soil. The first is much weaker than the second, save when soluble manures have been recently applied to the surface.

13. The annual average loss of lime and magnesia by drainage from the continuously unmanured wheat-plot, is apparently about 223 lbs.; where 400 lbs. ammonium-salts are applied, the loss is 389 lbs.; where sulphates of sodium, potassium, and magnesium are also added, the loss is still greater; the two last-named salts exerting most influence. Nitrate of sodium does not apparently increase the loss of lime.

14. The chlorine and soda applied in manure are retained to only a small extent, either by the wheat-crop or the soil; sulphuric acid is retained to a somewhat greater extent. Phosphoric acid and potash are very perfectly retained, the part unassimilated by the crop being held by the soil, chiefly in the upper layers; this is especially true of phosphoric acid.

15. The quantity of nitric acid lost by drainage from unmanured land cropped with wheat, is far smaller than that lost by uncropped land, the crop assimilating the nitrates formed. In summer the drainage-waters contain little or no nitrates; after harvest nitrates reappear, and are found in the waters through the winter.

16. When ammonium-salts are applied to land, the ammonia is at first retained by the soil, while the sulphuric acid or chlorine passes into the drainage-water, chiefly as calcium salts.

17. The conversion of the ammonia into nitric acid commences almost immediately after the application of ammonium-salts to wet soil, the conversion is apparently complete in a few weeks if wet weather follows. The nitrogen of rape-cake is more slowly converted into nitric acid.

18. The drainage-waters from plots manured with ammonium-salts are richest in nitrates shortly after their application. With 400 lbs. of ammonium-salts per acre applied in March, the April drainage-waters have averaged 6·7 lbs. of nitrogen (= 42·8 lbs. nitrate of sodium) per inch of drainage.

19. With an equivalent amount of nitrogen applied at the same time as nitrate of sodium, the April drainage-waters have contained 11·8 lbs. of nitrogen (= 75·6 lbs. nitrate of sodium) per inch of drainage.

20. In summer the drainage-waters from plots receiving 200–400 lbs. ammonium-salts contain little or no nitrates if phosphates and potash have been supplied; but with an excess of ammonia, or a deficiency of ash-constituents, the nitrates produced are imperfectly assimilated by the crop, and appear in the drainage-water.

21. In winter time the drainage-waters from all the plots tend to approximate in composition.

Quantity of Nitrogen Lost per Acre by Drainage.

22. Taking the average of two seasons of excessive drainage, but for which we have analyses of every running from the drain-pipes in the Experimental Wheat-field, it was estimated that from 15 to 17 lbs. of nitrogen were lost per acre per annum by drainage from plots which had received no nitrogenous manure for many years. Nearly the whole of this loss occurred during the period of the year when there was either no crop on the ground, or but little growth.

23. With 44, 88, and 132 lbs. nitrogen applied as ammonium-salts in the spring, the estimated loss by drainage was 22, 28, and 42 lbs. of nitrogen per acre per annum. With 88 lbs. of nitrogen applied as ammonium-salts, without or with different mineral manures, the loss ranged from 28 lbs. with the most liberal mineral manure, to 50 lbs. without any mineral manure for many years. The loss was the greater, the greater the deficiency of available potash and phosphoric acid in the soil. With nitrate of sodium, spring sown, the loss was greater than with ammonium-salts; but it was greater still with ammonium-salts, autumn sown.

24. Reckoned over thirty years, with much better average seasons, the estimated loss by drainage was from 10 to 12 lbs. of nitrogen per acre per annum, without any nitrogenous manure. With 43, 86, and 129 lbs. nitrogen applied as ammonium-salts, in most years autumn sown, the estimated loss was 19, 31, and 42·4 lbs.; and with 86 lbs. nitrogen applied, without, or with different mineral manures, the estimated loss ranged

from 31 lbs. with the most liberal mineral manure, to 43·2 lbs. with the ammonium-salts continuously used alone.

25. Reckoned over thirty years, not quite one-third of the nitrogen supplied by manure was recovered in the *increase* of crop under favourable conditions as to mineral manure and growth, and very much less when there was a deficiency of potash and phosphoric acid, and defective growth accordingly.

26. With 400 lbs. of ammonium-salts, and the most liberal mineral manure, there was the maximum amount of nitrogen recovered in the crop, and the minimum amount in the drainage; but with the ammonium-salts used alone, there was the minimum amount in the crop, and the maximum amount in the drainage.

27. Only with the smallest quantity of ammonia applied was the amount of nitrogen in the total crop and drainage together, more than was supplied in the manure; in all other cases there was a greater or less deficiency. Besides the nitrogen supplied in manure (which was not entirely recovered in the crop and drainage), it is estimated that on the average about 30 lbs. would be contributed per acre per annum by the soil and by rain, and condensation of combined nitrogen from the atmosphere; perhaps more by the soil in the earlier, than in the later years.

28. Analyses of the soils of the different plots, made at different periods, show that the amount of nitrogen was considerably reduced where no nitrogenous manure was applied; but where nitrogenous manures were applied, the amount remained stationary, or slightly increased, or diminished, according to the condition of the soil as to mineral constituents, and to the amount of growth. In fact, the difference in the amount of nitrogen in the soils of the plots with ammonia applied, compared with that where none was applied, bore a close relation to the amount of growth, and was mainly due to the residue of the crops.

29. The amount of nitrogen in the crops, and estimated to be lost in the drainage, together with the excess in the soil where it was supplied in manure, is not sufficient to account for the whole of that so applied, and that available from other sources; but there is evidence that, reckoned according to the composition of the collected drainage-waters, the estimates of the loss of nitrogen by drainage are too low.

30. When farmyard-manure is largely used, there is sometimes considerable loss of nitrogen, due to the decomposition of nitrogenous organic matter, and the evolution of free nitrogen; or when the soil is saturated with water, or imperfectly aërated, there may be destruction of nitric acid and evolution of free nitrogen. It is believed that, under the conditions of the artificially manured plots in the Experimental Wheat-field, there

would be very little loss from either of these sources, and that the loss is almost exclusively by drainage.

31. In ordinary agriculture, with a larger proportion of the nitrogen supplied in farmyard-manure or animal-manures, with ammonia or nitrate used in smaller quantities, and with a variety of crops covering the ground with vegetation for longer periods of the year, the loss of nitrogen per acre by drainage will be considerably less than it has been shown to be in the Experimental Wheat-field.

Practical Conclusions.

1. Most of the nitrogen of farm-crops is derived from the nitric acid of nitrates within the soil.

2. The nitric acid in the soil is produced from the nitrogenous compounds of the soil itself, from the nitrogenous organic matter of animal and vegetable-manures, from the ammonia of artificial-manures, and from the ammonia supplied by rain and condensation from the atmosphere. A very small quantity of ready-formed nitric acid is supplied by rain and condensation from the atmosphere. Nitric acid is also provided by the direct application of nitrates.

3. The ammonia of ammonium-salts is rapidly converted into nitric acid in the soil, as also is the nitrogen of some organic matters, such as urine. The nitrogen of rape-cake, that of the less soluble parts of farmyard-manure, of stubble, of roots, &c., is much more gradually converted into nitric acid, and it may require many years for the conversion of the whole of it. The nitrogenous compounds of the soil itself are very slowly converted into nitric acid, but the soil yields a certain quantity every year.

4. When there is no vegetation, and there is drainage from the land, or even when there is vegetation, and excess of drainage, nitric acid is lost by drainage.

5. As in the case of permanent grass-land the soil is always covered with vegetation, there will be with it the maximum amount of nitric acid utilised by the crop, and the minimum amount lost by drainage. Land without vegetation will be subject to the maximum loss of nitric acid by drainage.

6. The power of a growing crop to utilise the nitric acid in the soil is much diminished if there be a deficiency of available mineral constituents, and especially of potash and phosphoric acid, within the reach of the roots.

7. As the various crops grown upon a farm differ very much as to the period of the year of their most active growth, the length of time they remain on the land, and the character and

the range of their roots, their capacity for taking up nitric acid from the soil is very different.

8. The recognised exhausting character of corn crops is largely due to the limited season of their active growth, and the long period during which the land is bare, or there is little growth, and so subject to loss of nitric acid by drainage.

9. When salts of ammonium, or nitrates, are applied as manure, the chief, if not the only unexhausted residue of nitrogen left within the soil available for future crops, is that in the increased roots and other residues of the crops; and this is only slowly available.

10. When oilcakes or other foods are consumed by stock, the formation of nitric acid from the manure produced is slower, but continues longer than when salts of ammonium are used. When there is a liberal use of animal-manures, an accumulation of nitrogenous and mineral matter takes place in the soil, and such accumulation is known under the term "condition." Under such circumstances the fertility of the soil is maintained, or it may even be considerably increased.

II.—*Hints on Vegetable and Fruit Farming.** By CHARLES WHITEHEAD, F.L.S., F.G.S., of Barming House, Maidstone.

THE problem of the Future of Farming appears difficult of solution. Some alarmists hold that the British farmer's occupation is gone; while others believe that the situation merely necessitates a change of system, and that if he energetically levels up his practice to meet altered circumstances, he may still have a profitable business. There are clear-headed men, gifted with an intuitive faculty of perception, and whose judgments are unaffected by panic, who say that corn-farming, pure and simple, will again pay in this country where the conditions are suitable, especially if some unfair burdens are removed from land, as they undoubtedly will be now that they have been so clearly set forth and brought prominently under the notice of the country and the Legislature. Every one knows that the wretched state of agriculturists during the last three years has been mainly caused by a cycle of wet seasons, which has happened before, and will happen again in due meteorological order. Most of the produce was of inferior quality during this cycle, and realised lower prices on account, in a degree, of the importation of the products of other countries, to the great advantage of the consumers. But this by no means is to be the normal state of our agriculture. Cycles of fine weather again will bring cycles

* This paper has been published by the Society as a pamphlet, price 1s.

of prosperity and contentment in Arcadia. There also are signs that the cost of the production of wheat will be increased in the United States, and that the effect of competition with that country will not be so disastrous to the home wheat-producer as some have prophesied. Fortunately there are other things than wheat for the English farmers to depend upon. There are meat-making, which will not for a long time, if ever, materially be interfered with by foreign competition; barley growing, wool producing, butter and cheese making, fruit, seeds, and vegetable culture, poultry rearing, and breeding of good animals of all kinds for home requirements and exportation. If we inquire what class of agriculturists have held their heads above water during the late hard times, it will be seen that those who may be termed specialists have fared the best, generally speaking. The term "specialist" includes all breeders of stock of reputation, vegetable growers, fruit growers, dairy farmers, and seed growers.

There is an increasing demand in all countries, from China to Peru, for English breeding-stock of all descriptions. The statistics of the annual statement of the Board of Trade show that whereas the number of live animals, horses, cattle, sheep, and pigs, that were exported from this country in 1875 was 9572, of the declared value of 314,012*l.*; the number exported in 1880 had increased to 16,672, of the declared value of 425,400*l.* Surely there is room for a great extension of this trade. Foreign buyers would be encouraged by the lessened prices that would result from more breeders going into this business, and these prices would still be most remunerative. The noted herds of some English breeds are, in certain instances, so much reduced by the demand from abroad, that the old saying has been quoted as to killing the goose that lays the golden eggs. This was urged as a reason for the short entries of some breeds of horses and cattle at the last Show of the Royal Agricultural Society at Derby. The exportation of fine wool from England is increasing in a rapid ratio. In 1875, 10,536,523 lbs. of wool were exported from the United Kingdom, and 17,197,300 lbs. in 1880. The exportation of seeds has increased in this same period from 119,060 cwts. in 1875, to 125,742 cwts. in 1880, and buyers from all countries are always ready to purchase good seeds of new varieties, or seeds of the best varieties of all kinds of cultivated plants.* We must endeavour in every way to increase the exportation of specialities, and indeed all kinds of farm produce, and to keep up the reputation which the energy of the English farmers and the peculiar suitableness of the soil and climate have gained. Instead of looking back to

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* Many seed potatoes have been exported to the United States this spring from this country, and cob-nuts were sent from Kent to New York last season and found favour among epicures.

Protection and turning ready ears to those who advocate unsound doctrines of political economy, we must try to make our stock, our wool, and all our produce as good as possible, and much desired by the people of all nations.

There also is a great and an increasing demand at home for the minor products of the land, some of which may now be classified as necessities ; others in a degree as luxuries, because of their high prices. Fine qualities of cheese, good butter, milk, cream, eggs, chickens and poultry of all kinds, would have an extraordinary sale if only the prices were reasonable. And there is no doubt that all these things could be produced for sale at reasonable rates, and at the same time would yield a good profit if farmers would direct their minds and their energies to the work. Foreign competition will not interfere with these industries. This game, at all events, is in the hands of the home producers. The chief drawback to the full development of this trade is the unsatisfactory present mode of distribution of nearly all kinds of farm produce, and especially of these minor kinds. In existing circumstances, the producers get the minimum value, and the consumers have to pay the maximum price. The pernicious system of salesmen and middlemen, and the routine of markets, hinder enterprise and check production. In no cases is this so much felt as in those of vegetables and fruit, which are confined to a few centres—markets, for the most part, utterly inadequate for anything like general distribution. Even with the system now holding, it is fully believed that the production of vegetables, salad plants, and fruit could be very largely extended, to the gain of the cultivators and to the infinite satisfaction of would-be consumers who live in towns, and of those who have no gardens, who constitute a vast proportion of the population. This paper, therefore, has been written at the request of the Council of the Royal Agricultural Society, to point out the importance and advantage of adding these special cultures to the ordinary farm crops, and to give some practical information as to the most desirable sorts of vegetables and fruits for this purpose, together with details as to the modes of cultivating them, and the circumstances of soil, climate, and situation that are required.

It is not by any means suggested that vegetables and fruits are to be made at once to take the place of corn and other customary crops of the farm, nor that their cultivation should be generally and indiscriminately adopted ; but it is desired to show that vegetables may be extensively grown in rotation with ordinary farm crops, as the practice is in Essex and other counties ; also that a few acres of fruit-land may advantageously be added to almost all farms ; and in some cases large plantations may be made. Before proceeding to descriptions and details, it will be

desirable to mention, and if possible to meet the objections that are urged by interested, and, it is also fair to say, disinterested persons, against a considerable increase in the vegetable supply. Market-gardeners proper say that their profits have considerably diminished, and also that occasionally the markets are glutted with vegetables. No doubt the market-gardeners whose land is situated within 20 miles of the metropolis have lately felt the competition of farmers, who ought to be able to produce vegetables more cheaply, since their rents are lower and their taxation is not so heavy, and they have the advantage of being able to vary more frequently the courses of cropping upon the larger area of a farm. Farmers also within reasonable distance of London now have equal facilities of transporting vegetables to the markets, and of getting manure from the London stables and cow-sheds by rail. Market-gardeners undoubtedly have made large profits, and naturally object to their reduction. The amount of capital they require per acre necessitates large returns, but it is maintained that farmers can produce vegetables without much additional capital, at a profit that will completely satisfy them. Then it is said that sometimes there are gluts of vegetables, and that greenstuff is wasted or sold at unremunerative prices. As it is mainly in the articles of cabbages and greens that gluts occur, and it must be said that these are not of frequent occurrence, farmers would be able to feed their sheep with them, and thus have an advantage over market-gardeners. But gluts are chiefly caused by the growers crowding all their produce into two or three markets in London even from long distances, and generally from the want of adequate means of distribution; for it is certain that only a comparatively small radius around the London markets feels the full effect of an excessive supply of these vegetables. The same holds with regard to large towns, such as Manchester, Birmingham, Liverpool, to which market growers from far and near send all their vegetables without any reference to the demand. The area of the distribution of a market is necessarily limited. Multiplication of markets implies large outlays of money and additional cost ultimately to the consumers for tolls. Markets also necessitate middlemen, whose large charges above the cost price of the articles are also paid by the consumers. In order to get the actual market value of their commodities and to give the same benefit to consumers, producers must combine to form Supply Associations in various parts of large towns, or make arrangements and contracts with retailers to send them certain vegetables. This applies to fruit equally as to vegetables and to most other products of the farm.

The large and increasing importation of foreign vegetables is used by some as an argument against more vegetables being

raised in England; but cabbages and greens of all kinds are not imported to any extent, being too bulky, and the season for imported cauliflowers and other vegetables practically is over before the English season has begun. The season of imported fruits likewise is for the most part over before those grown in this country are ripe. It is thought that a large trade might be established with France, Holland, and Belgium in fruit grown in England, coming as it does when the season of the common fruits of the Continent has passed. There also is a wide field for energy in the adoption of systems like those of the market-gardeners at Vaugirard and other places near Paris, of growing early vegetables under bell-glasses, and frames and lights. English producers surely might supply the large towns with salad-plants grown under glass, and, later on in the season, out of doors, more cheaply and certainly in a more fresh condition than the French gardeners. The quantity of these salad-plants imported is enormous, and it is increasing, because practically the importers now have the field to themselves. Early fruits also could be grown on a large scale under glass to compete with those that come from the Continent. In short, if well-directed and well-sustained attempts were made to produce early vegetables of excellent and good appearance, it is believed that the foreign growers might be ousted after a time. It may be thought that these are too trifling details for farmers proper to worry themselves about; but every farmhouse has its garden, whose soil and situation are in nine cases out of ten the best on the farm, and which is too often the worst-farmed part of the land; this entails the services of a gardener, or a workman who knows something of gardening, occasionally or permanently. A better gardener or an unusually intelligent labourer might be employed, and the garden should be considered as a source of possible profit, and tilled and tended in the most careful manner, and extended to the farm land as circumstances might warrant. Near towns it would be found that dealers would come out and take vegetables and fruit, until the quantity he produced would enable the farmer to consign to market on his own account, or to make arrangements with Supply Associations or retailers. In this manner what may be called the garden of the farm would be developed from the nucleus of the existing garden. All kinds of smaller herbs could be produced. Cultivation under glass might be adopted in the gardens of farms far more than it is at present, and with much profit and advantage, in the production of cucumbers and early salad plants, and gradually increased if found desirable. This might be done not only with bell-glasses and handlights, but also with frames and protection to fruit-trees on walls, and with also cheaply-built greenhouses. Flowers

might be turned to profitable account. Upon the home gardens of market-garden farms it will be found that every spare product of vegetables, fruit, flowers, and herbs is sold, and spaces are reserved for seed-beds to supply the farm with plants. The cautious farmer may feel his way by means of his home-garden to gardening upon a large scale on his farm.

Another objection that is raised against extending vegetable culture is, that it would require a larger supply of labour than ordinary villages could furnish. This undoubtedly would necessitate additional labour, and create a demand which, however, it is believed, would soon be met. The better prices which farmers would be enabled to pay would attract labourers to the country, and tend to keep in their native places the young men who now leave them to better themselves. Immigrants would come at busy times, as they come to the Essex and Bedfordshire market-garden farms, as they go turnip-hoeing and harvesting in various counties, as they come into Kent for fruit-picking, potato-digging, and hop-picking. The additional culture of vegetables, within certain limits, would not much clash with ordinary farm work, and would, if well managed, ensure constant employment for labourers all the year round. Now it happens frequently that unremunerative work has to be found at some periods of the year for the regular staff. Upon ordinary farms a staff has to be maintained principally for the important operations of turnip-hoeing, hay-making, and corn-harvesting. Vegetable culture could be arranged to work well in with these seasons. Much of the lighter work, as picking peas, pulling and bunching onions and carrots, could be done by women, who could also wash those vegetables that required washing, in sheds or barns, and bunch them and pack them for market. There would be plenty of work for the staff of labourers in winter in sending off stored carrots, or stored potatoes, or onions, or parsnips, or celery, or protecting radishes or lettuces, in gathering Brussels sprouts, and in various other ways.

Vegetable culture is supposed to require almost fabulous quantities of manure. Without any doubt the system of growing vegetables practised by market-gardeners near London, who are not satisfied unless they get two exhausting crops in a year from each part of their holdings, entails immense manurial applications. As much as 30 tons of farmyard-manure are put on per acre for some crops, and even 50 tons per acre for celery. Upon two market-gardens visited in Essex, the average annual cost of manure was in one case 10*l.* and in the other 11*l.* per acre. On the other hand, upon a profitable market-garden farm visited in Essex the average annual cost of manure was only 2*l.* 10*s.* per acre; yet all the crops on the 200 acres, including cabbages,

peas, Lisbon onions, broad and French beans, potatoes, wheat, oats, were remarkably good. Crops of vegetables taken in rotation with corn and other crops do not require more manure than mangolds, or swedes, or beans. Neither does it follow that farm-yard-manure is indispensable. Upon the market-garden farms in Essex large quantities of horse-hoof parings, horn-shavings, fish refuse, and other refuse, are used in alternation with farm-yard-manure; nitrate of soda and guano are also freely put on. Rape-dust might be used also with great advantage for many gross-feeding vegetables, as it is found to be one of the best manures for hops in Kent, Sussex, Hampshire, and Surrey.

Upon most farms there are some spots, some fields, that are suited for vegetables, if well and properly cultivated. It is a mistake to suppose that land for this purpose must naturally be of exceptional quality. Much of the land in Essex and other market-garden districts, is by no means fertile by nature; nor is the sandy soil round Biggleswade in Bedfordshire especially rich. Land that will grow turnips and mangolds well will grow cabbages and other plants of the Brassica order. For onions, French beans, carrots, parsnips, and lettuces, fairly good soil is necessary, and soil that works well and does not bind. Peas for podding and broad beans flourish in those soils where field-peas and beans thrive. The loams and clayey loams of the Lower Greensand, of the Upper Greensand, of the Lower London Tertiaries, answer well for vegetables. Also the lighter marls of the Chalk, and the more friable clays of the Old and New Red Sandstone, and the Lias, and the peaty lands in parts of Lancashire and other counties, also much of the alluvial and drift soil, would answer admirably for their growth. It would perhaps not be too much to say that upon all soils where potatoes are successfully grown, the more common kinds of vegetables would do well. Except in the extreme north of England, the general climatic conditions of most of the counties would be propitious, if judgment were exercised in the selection of favourable situations, sheltered from prevalent winds in the bleaker districts. On almost all farms there are slopes and bottoms where protection of this kind is afforded, and fields near the farmhouse comparatively sheltered, where the best of the land is generally to be found, upon which vegetables would flourish.

Vegetable Growing.

In giving a list of the crops suitable for market-garden farming, and a short account of the modes of cultivating them, it will be well to commence with Cabbages, as they are easily cultivated, and are the crop upon which farmers usually try their 'prentice

hands. These may take the place of mangolds or turnips in the routine of farm crops, and, as has been suggested, they form marvellously good food for ewes and lambs if they cannot be sold for vegetables. There really is no more expense in the cultivation of cabbages fit for human food than in that of cabbages for cattle, and the profit from them in some seasons is highly satisfactory. Supposing the plants were put out at the end of September upon land well manured, they might be cut for market upon the first approach of spring, or even in the winter, if it were mild, they might be sold as greens, known as Coleworts, or "Collards;" or in May and June as perfect full-hearted cabbages. Sometimes coleworts make very high prices when green stuff is scarce, as much as from 8*s*. to 12*s*. per dozen bunches, each bunch being about a handful. As from 140 to 300 dozen bunches are grown per acre, the proceeds sometimes are very large. The Blue Colewort, Cock's Hardy Green, and the Rosette are sorts adapted for this purpose, but these do not make good hearts; and the best sorts for cabbages proper, with good hearts, intended for spring cutting, are the East Ham, Enfield Market, Sugarloaf, Battersea, and Wheeler's Nonpareil, among others.

Cabbage-plants are grown in seed-beds, usually in strips about 5 feet wide. About 10 lbs. of seed are sown per acre on these beds towards the end of July, for winter planting, and the beds are carefully hoed over when the young plants are up, which are slightly thinned, and all the deformed plants are pulled out. For cabbages the plants are put out 22 inches by 20 inches. For coleworts they are set 12 inches, or 14 inches each way. One acre of seed-bed will plant about 15 acres of coleworts or about 20 acres of cabbages. Great care must be taken in the selection of seed of full germinating power and true to sort, and much attention must be paid to sow the seed deeply enough, yet not too deeply, in the seed-beds. In ordinary seasons cabbages will be cleared off by the end of June, and might be followed by wheat; or, if another crop of vegetables were desired, the ground might be prepared for autumn-sown onions; or a crop of potatoes might be obtained by putting them in as fast as the cabbages were cleared off. In early seasons sometimes a capital crop is grown in this way,* and in this case the land would then come in for winter tares, or be ploughed up for oats or barley. If dealers do not take the cabbages, they could be carted to the nearest town upon waggons with springs, made expressly for the purpose, which take huge loads; or to the railway station, where the cabbage can be moved into trucks, or the waggon itself taken

* There are quick growing kinds of potatoes, suited for this purpose. Among these is the Red Bog, which being planted at the end of April is fit to dig in August.

to its destination on a truck, and brought back full of manure. 190 dozen of cabbages can be piled upon these vans, which are drawn by two powerful horses. About 1000 dozens of cabbages are produced per acre on an average, and the price ranges from 7*d.* to 1*s.* 4*d.* per dozen, and even higher occasionally. Cabbages also are planted in the spring for late summer or early autumn cutting.

ONIONS are a most paying crop, though more risky than cabbages, being liable to mildew, and entailing more outlay for labour. It is not well to crop the same field with onions more than once in five years. They may be taken after spring-sown cabbages, or mangolds, or carrots; or, as is done in Essex, cucumbers, which only stay in the ground a few weeks, are taken after spring cabbages, and onions follow the cucumbers. For onions it is required that the ground should be well worked, but at the same time it must have a fairly firm surface. If they are for seeding, or for pulling early, for which a sort known as the "two-bladed" is the best, it is better that the farmyard-manure should be scuffled in, and not buried by the plough. About 60 lbs. of seed are sown broadcast and harrowed lightly in, as early as possible in the spring, so that there may be no danger of frosts, which much injure the tender shoots.

Pickle-makers make contracts with growers for onions, and a considerable amount of labour is required to pull them and peel them. If onions are intended for "bulbing," that is for large bulbs for storing, very much less seed is sown. It is an expensive process to keep the ground free from weeds where pickling or salad onions are grown, costing from 4*l.* to 5*l.* per acre. The gross return in exceptionally good years amounts to 150*l.* per acre, as was shown in the Report on the Market-garden Farm Competition in 1879.* Lisbon onions are sown in the autumn for "bunching." About 50 lbs. of seed are sown broadcast upon well-manured and well-prepared land; the onions are pulled in May and June, and are sent to market in bundles containing as many as a man can hold in his hand arranged in a fanlike shape, packed in layers in baskets for salads and for eating in the way in which labourers so enjoy them, raw with bread and cheese. These return, in good seasons, as much as from 50*l.* to 70*l.* per acre.

CARROTS are also a favourite crop of market-garden farmers, who grow them upon a large scale, and it is not uncommon to see fields of seven and even ten acres planted with them. Gardeners who live near towns often make a good thing by

* 'Report upon the Market-garden and Market-garden Farm Competition, 1879.' by Charles Whitehead. 'Journal of the Royal Agricultural Society,' vol. xv. s.s. Part II.

getting carrots early, and a few pounds might be made in this way in many farm-gardens without much trouble. Carrots are extensively grown by market-garden farmers and market-gardeners for "bunching"—that is for pulling when quite small. They may be taken after potatoes, or coleworts, or cabbages. The land requires to be well ploughed in the autumn, and well-made farmyard-manure should be scuffled in, and about 10 lbs. of seed, mixed with a little finely triturated earth sown broadcast as soon in the spring as the weather allows. Pulling is commenced when they are about half an inch in diameter. From twenty to forty are put in a bunch. The bunches are packed in crates and baskets, and bring from 2*s.* to 3*s.* 9*d.* per dozen bunches, coming to market after the French early carrot season is over. From 300 to 400 dozen bunches per acre are a fair crop. This crop is a very little while on the ground, but entails considerable labour in keeping the land clean from weeds. Cabbages may be taken after carrots, or wheat, or winter oats; the Early Horn and James's Intermediate are the sorts usually grown. The Italian Early Market is also a good carrot.

PARSNIPS are a profitable crop upon suitable land. They require a deep tilth, or they become "forked." This can be obtained by means of a subsoil-plough, following the ordinary plough. Manure should not be directly applied for this crop; they may, therefore, well follow late cabbages, or onions, or Savoys, or even coleworts, as the most successful growers do not have a "stale furrow," but prefer to plough and sow as closely together as possible. The seed is drilled in with a seed-harrow, in rows fifteen inches apart, in the spring as soon as the weather permits, the plants being left about eleven inches apart in the rows. The Hollow Crown is the sort usually grown; indeed, there is scarcely any other sort. Parsnips are not dug until they are wanted for market, not being injured by frost. Parsnips can be followed by spring cabbages, for which a good coat of manure would be necessary, or by spring tares.

PEAS for podding are not, as a rule, very remunerative. Occasionally, however, it happens that a good hit is made, when, by good management, or from advantages of situation, a grower is able to keep his plant through a very hard winter, or has a specially good sort. If he is near a good town, a farmer might well plant a few acres of peas. Much also may be done in the way of growing seed-peas for seedsmen by contract, where conditions of soil allow. Sangster's William I. is a good early pea, and Sangster's Imperial No. I., Fill Basket, Forty Fold, and Veitch's Perfection, are suitable for growing crops to follow in succession. A fair crop of peas for podding amounts to about 150 bushels (of pods) per acre, and an average price, *wholesale,*

is about 2*s*. per bushel. Market-gardeners put peas between cabbages, and have many schemes for getting two crops from the same ground in the year; but farmers would hardly get labour enough for this system of double cropping. Still, in many circumstances, it would be well for them to watch their opportunity, and take lessons from market-garden practice. Thus, to quote the Report before alluded to, it is said of a market-gardener, "He sows onions, carrots, parsnips, spinach, peas and potatoes, in the early spring, after the winter green-stuff—such as hardy greens, or coleworts, Savoys, and purple-sprouting broccoli—has come off the land. After early cabbages, which should be cut in ordinary seasons by the end of May, he plants potatoes, scarlet runners, French beans, blue peas, beet, marrows, cucumbers and summer lettuces." Market-gardeners never lose a chance. Market-garden farmers are equally on the look-out for a "catch crop," and farmers who may add vegetable-growing to their business will do well to follow their example.

CAULIFLOWERS sometimes give most satisfactory returns, but as they require protection during the winter, they cannot compete on anything like equal terms with those grown in Cornwall, France, and the Channel Islands. Occasionally there are winters through which cauliflowers would live, but the risk is too great to plant them on a large scale, therefore it is better to get a supply of plants grown under glass, or in protected places, and plant them out as early in the spring as possible. Farmhouse-gardens in many respects are admirably suited for rearing and protecting these plants, and indeed for producing early cauliflowers, which in some seasons are worth almost their weight in coppers and pay well for care. Cauliflowers must have good land and a deal of manure, with considerable moisture. In other respects they are cultivated in the same way as cabbages; the plants being reared in seed-beds and set out on the land when the weather permits, from 24 by 18 inches to 24 by 24 inches apart, depending upon the quality of the soil. Mitchell's Hardy Early, Early London—more delicate—and the Dwarf Mammoth, Veitch's Autumn Giant and Walcheren, are good sorts; and it is best to arrange a succession of sorts, so that the supply may be continuous.

BROCCOLI will bear ordinary winters, and should be sown so as to ensure a proper succession of heads.* It may easily be arranged that there should always be broccoli fit to cut. They are cultivated like cauliflowers, and set the same distance apart. The

* Mr. Shirley Hibberd, in his 'Profitable Gardening,' says, "It is a mark of good management if the gardener can cut broccoli or cauliflowers any day in the year, and to do this requires that sort of headwork which, as Cowper says, 'Forecasts the future whole.'"

best sorts are the Hardy White, Snow's Winter White, Adams's Early, Grange's Early White, Early Penzance, and Leamington.

A few acres of cauliflowers and broccoli might be most advantageously grown upon farms having good land, and within reasonable distance of a town or of a railway-station, as they generally are most saleable commodities. They may be tried at first in a small way, and their cultivation could be extended if it was found that the surroundings were suitable and that they were profitable.

Brussels-sprouts—Chou de Bruxelles—are exceedingly good greens to grow for winter use, and have a sweet flavour after winter frosts. The habit of this plant is to produce many sprouts or tiny cabbages upon a long stalk; successions of these follow on the same plant throughout the winter and the spring; when the summer comes they go to seed. They are remarkably hardy and bear the coldest winters. No farm garden, nor any other garden, should be without these. They may be cultivated with advantage by market-garden farmers, and are largely grown in market-gardens near London. The plants are picked out in April in rows 22 inches apart and 18 inches from plant to plant. It is said that the English-grown seed is not to be relied on, and that the only neighbourhood where the seed is to be depended on is Brussels.

Lettuces may be deemed as hardly being vegetables for growth upon a large scale; but this crop sometimes makes a deal of money, without being very expensive to cultivate, and if vegetable-growing is seriously undertaken, no kind should be beneath consideration. They may be specially grown in the garden of the farm, in beds in the warm corners of many old farmhouses, or protected by hand-glasses; for English lettuces, fresh and firm, make long prices in the early spring-time, in spite of the competition of the French market-gardens. The great object is to get lettuces very early in the spring, and for this, of course, the plants have to stand the ordeal of the winter. Lettuces require a fairly good soil. Cos lettuces, or the crisp, juicy varieties, with erect leaves, which the English prefer, do best upon loam, or loamy clay-land, or even upon well-farmed, stiff clay. Cabbage lettuces, or those more resembling cabbages in shape, of which the best sorts are the Dutch, Asiatic, Hammersmith, Imperial Ice, which never bolts or runs to seed, will thrive upon sandy or chalky soils, if properly cultivated and well manured. The best sorts to stand the winter are the Bath Cos, Hammersmith, Silician, or Paris Cos. The seed should be sown about the first week in August broadcast, upon a well-prepared bed. About half a pound of seed is sufficient to furnish plants enough for an acre. Unless the winter is very severe, these will be

ready in May, and almost invariably make long prices. It would answer well to shake a little rough litter over them during the worst winter months. Enterprising men might invest in bell-glasses, which would ensure the preservation of the plants, and very early readiness for market. Lettuces for summer use are transplanted from frames or seed-beds in May, June, and July, with due regard to the succession of sorts and supply. Lettuces imported from France from January to June, make from 9*d.* to 1*s.* 2*d.* per dozen. English lettuces coming to market in the latter part of May make from 8*d.* to 1*s.* 3*d.* per score, and an average crop is about 1400 score per acre. Autumn-sown lettuces may follow onions, or late cabbages that have been heavily manured. Those planted in May and June might come after coleworts or spring cabbage.

RADISHES are much cultivated by market-gardeners. The turnip-radishes, of which the best kind is the French Breakfast radish, are sown broadcast upon beds five feet wide, with a space between each, either in the late autumn or in the early spring. In the former case the plants must be lightly covered with litter. Spring radishes are only a short time on the ground, and would come off together with autumn-sown radishes in time for lettuces, French beans, or marrows. They are sent to London in bunches, each containing a large handful, and are sold at from 4*d.* to 8*d.* per dozen bunches. There is a great demand for well-grown English radishes throughout the spring and early summer, especially after the season of those imported from France is over. It is not suggested that radishes should be universally grown. They may, however, occasionally be taken as a crop by farmers who have land of fine tilth particularly adapted for market-garden culture, and they are just one of the subjects for cultivation in the home garden.

FRENCH BEANS AND SCARLET RUNNERS are grown extensively upon market-garden farms in Essex and Surrey. Both these are delicate plants, and require a fine tilth. The land is ploughed twice, manure not being directly applied. The seed is dropped by hand in drills made with a hand-plough. French beans are set $2\frac{1}{2}$ feet apart, and 8 inches or 9 inches in the drill. Scarlet-runner rows are put 3 feet apart, and the seeds are dropped into these about a foot distant. These are very delicate plants, and are cut up by the least frost, and, when the plants are young, are injured by excessive wet. Slugs do great harm to them. Stakes are not put to scarlet runners in the field. Their habit is dwarfed and made upright by cutting off the tops of the shoots. It should be borne in mind that French beans have not much chance of ready sale when there are plenty of scarlet runners ready.

CELERY is most profitable in soils and situations that suit its growth. Well-grown, well-blanched, short-eating celery is always a most saleable commodity. The cultivation requires much care and involves considerable expense, and is perhaps, as it may be thought, more suited for market-gardeners than for farmers, but there is no reason why it should not be more largely grown in farm gardens and for market purposes. There are market-gardeners near London who grow as many as 50 acres of celery. The seed should be sown first in frames with a little heat, towards the end of February, from whence the plants are put out into rows 5 feet apart, with a few inches between each plant. Quantities of well-rotted manure must be put on before the plants are put into rows or trenches, which should be dug out to a depth of from 1 foot to 15 inches. When the plants are about 16 inches high they should be earthed up slightly. After a short interval they should be earthed up again, and this must be repeated until the earthing-up is completed. Celery may be planted after cabbage, or broccoli, or early lettuces, and the plants are put in early in May.

MARROWS AND CUCUMBERS are grown upon market-garden farms, but their culture is somewhat hazardous, though they do not remain long on the ground. The least frost, or too much wet, injures the plants. Some growers sprout the seeds in flannel, but this renders them delicate. The seed is put in rows 4 to 5 feet apart, early in May. The plants are rarely transplanted where cucumbers are grown on market-garden farms. There are special kinds of cucumber for growing in the open air, and upon ridges, among which are the Early Short Prickly, Sutton's Perfection, Rabley Prolific. Between the rows a drill of rye is put in as a shelter. Occasionally scarlet runners are grown between the rows to serve as a protection. These cucumbers make from 3*s.* to 4*s.* per barrel; from 175 to 200 barrels are grown per acre.

TOMATOES are not grown nearly so much as they should be; the taste for this vegetable is increasing rapidly, both for eating raw, according to the American fashion, or for boiling or baking. They thrive well under the protection of buildings, and there are many neglected corners and borders near farmhouses and farm-buildings where tomatoes would flourish, protected from fowls and other creatures by galvanised wire-netting. Plants may be obtained by sowing seeds in shallow pans or boxes in March and April, and transplanting into pots, and finally, when large enough, they should be topped and planted out. The great thing in the cultivation of tomatoes is to keep pinching off the heads continually and to cut away all secondary shoots on which no flowers are forming. Or five or six seeds may be sown towards

the end of April where the plants are required, so that no transplanting is necessary, and the strongest plants should be retained and trained to a wall or to a stake, and the pinching and topping process done as often as necessary. The plants require watering if it is dry, in their early stage.

CABBAGE, CAULIFLOWER AND BROCCOLI PLANTS may be grown for sale with good results. Upon a farm in Essex, visited in 1879, several acres of cabbage-plants were sold at 40*l.* per acre, having only been eight weeks on the ground. The seed was sown in August, and the plants were cleared off by October, in time for wheat to be sown. A splendid crop of carrots (bunched) had been cleared off in July.

The cultivation of seeds is frequently productive of much profit, especially of ONION-SEED, and MANGOLD- and TURNIP-SEEDS, which are grown very advantageously by market-garden farmers and by farmers. Mangold-seed is grown from seed drilled in a seed-bed at the rate of 1 cwt. per acre, which will give plants enough for 6 acres. The plants are left in the seed-bed till early in April, when they are transplanted in rows 20 inches apart, with intervals of 20 inches between each plant, in the rows. Cutting is done in September before the seed is fully ripe, as it will run out if it is allowed to become too ripe. The seed-stalks are bound up in small sheaves and are thrashed by a machine. An average crop of seed is about 18 cwt. per acre. Prices run from 28*s.* to 60*s.* per cwt.

SEED-PEAS are also grown in parts of Kent, Essex, and other counties to great advantage. These are generally grown for seedsmen, who find the seed and pay so much per quarter for the produce. In a few cases farmers grow seed-peas on their own account. There is a demand in America for good sorts of peas for podding, which farmers may just as well supply as the seedsmen.

TURNIP-SEEDS of different sorts are grown from plants transplanted from a seed-bed in November, and set at about the same distance as the mangold-plants. The stalks are cut in July. An average yield is 25 bushels per acre, and the price runs from 14*s.* to 25*s.* per bushel.

RADISH-SEED is generally obtained from seed sown in the spring, with the surplus plants hoed out. An average crop is 22 bushels per acre, and the price is about 20*s.* per bushel. It is a bulky, troublesome crop to harvest.

There are other seeds that might be grown by the farmer, and other vegetables and herbs that could be cultivated. POTATOES have not been alluded to, as they are already largely grown by farmers. Market-garden farmers do not, as a rule, grow many potatoes. When they do grow them they generally plant early

sorts, and send them to market directly they are fit to dig. TURNIPS also bring high prices in some seasons, and there would be no difficulty in getting an acre or two sown with White Dutch or Early Stone turnips in March for market, if prices were good ; there would be no loss here, as they would come in for the sheep if they could not be sold. Various small things might be raised in farm-gardens which would bring in ready money and be very profitable. These cultures should not be despised because they are trifling and insignificant. Parsley, mint, thyme, beet, asparagus, and other herbs and vegetables are among these things. Those that have been enumerated above are the most important, and most suitable for cultivation upon a large scale. When the cultivators have found out the pleasant results of growing those that have been described, they will be keen enough to adopt any others which they may think will pay.

FRUIT-GROWING.

Many of the remarks that have been made concerning vegetable-growing will equally apply to fruit-growing. By far the greater part of the land in England will grow fruit of some sort or other. The sorts that may be peculiarly suited for certain districts may be ascertained from examination of the fruit-trees in the gardens, and, at least in the case of quick-growing bush fruit-trees, by planting some as an experiment. The garden of the farm should be made the base of operations with fruit-trees as with vegetables, and the extension of their culture may be made large or small, with these fruits, or with those fruits, according to circumstances. It would for instance be most unwise to form an apple-orchard or a cherry-orchard or plum-orchard in a locality where these fruit-trees had previously not been cultivated, until careful inquiry had been made and the opinion of experts obtained ; or to plant any particular sorts of these without first finding out, as far as possible, whether it were likely that the conditions of soil, climate, and situation would suit them.

A tenant would hardly plant fruit-bushes or fruit-trees unless he had a lease ; he should also have a guarantee of payment for the increased value that he had imparted to the land. He would hardly be justified in planting standard fruit-trees unless he were assured of definite and sufficient compensation for this improvement. In some fruit-growing counties it is customary for the landlord to find the standard trees and the tenant to pay for planting them, but no special compensation for unexhausted improvements is allowed. In the Agricultural Holdings Act

planting orchards is one of the thirteen improvements of the first class, which continue unexhausted for twenty years, and it would give a stimulus to fruit-planting if tenants could be guaranteed compensation even at this rate, which, however, is not by any means adequate in the case of apple, pear, and cherry-trees. The uncertainties of land-tenure have much hindered the increase of fruit-land. Some few tenants who are of a confiding nature and have "long leases and practical landlords," as a large fruit-grower remarked lately, do plant fruit-trees; but most tenants are bound to require something more than this before they thus improve the property of other persons. To make fruit-plantations, and apple, pear, plum, and cherry-orchards especially, is to improve land in an extraordinary degree, more particularly in these days, and owners of land should encourage this by taking upon themselves a fair share of the cost, and by guaranteeing just compensation.

Supposing all difficulties of this kind adjusted, the farmer willing to try fruit-growing cannot do better than plant red currant, or black currant, or gooseberry-bushes, either by themselves or with standard or half-standard apple-trees among them, or plum- and damson-trees, or pear-trees, according to circumstances. He must select a fairly good soil and the best-sheltered situation.

Gooseberry and red currant-bushes do well on light, porous land or in good loam and clay-loams. Black currants require a deep soil, retentive of moisture, and will thrive in all the better descriptions of clay land. These bushes should be set 6 feet apart each way, which would take 1210 bushes. The land should be well manured and deeply steam ploughed, or ploughed deeply, with a subsoil-plough following. If standards are put in they should be set, if apple-trees, from 24 to 30 feet apart each way, which would give 75 and 48 trees respectively per acre. Plum- and damson-trees would be put about 15 feet apart each way, or 193 trees per acre. Should no standards be planted, the bushes may be put 5½ feet apart each way, giving 1440 to the acre. Upon strong land black currants should be set 6 feet apart, as their growth is very luxuriant.

GOOSEBERRIES.—The plants are easily raised by taking straight pieces of the cuttings 8 inches in length from the bushes, and setting them in rows, in a nursery in the autumn, without taking out any of the eyes, or buds. In two years they will be fit to plant out if carefully tended, and in two years after they will have fruit worth picking. Good plants can be bought in fruit-growing districts at from 6*s*. 6*d*. to 12*s*. per 100. Pruning is done from October until the end of January. The rank-growing shoots and branches are cut away, and a moderate

supply of young wood is left in the bush, which should be shaped like a cup. The branches should be trained to droop somewhat. If cut in this way they do not feel the effects of spring frosts so much as if they were left to grow quite upright. The choice of the sorts of gooseberries must in a degree depend upon the locality, but in most places those named below may safely be planted. For example, the Whitesmith is a capital gooseberry for picking green, and comes early, but is not so good for sale when ripe, as consumers like red fruit best, which always has a better flavour. The Early Sulphur is also good for picking green. When ripe it is yellow, and of second-rate quality. The Crown Bob is a famous sort, with a large red fruit, and answers for picking green or ripe. Probably the best of all is the Warrington for picking green or for picking ripe for preserving. It is an early sort for picking green, yet is about one of the last to come to full ripeness. A good proportion of a farm plantation should be planted with this. The Lancashire Lad is a useful sort for farms, as also are the Red Rifleman, Golden Drop and Monarch. There are other sorts raised in Lancashire, the great centre of prize gooseberries, concerning which fables are narrated. Of these the best are the Roaring Lion, Leveller, Leader, Napoleon, and Careless. These may be cultivated with good results in the gardens attached to farms, and should be sent for sale in small quantities, being showy fruit, and should be packed in neat baskets and tastefully set off. The garden may also be turned to good account in the production of early gooseberries in sheltered spots, for sending to market green for puddings and tarts, for which sometimes as much as 8*d.* or 9*d.* per lb. is given. The ground is dug with a three-pronged spud in the winter, and is manured with rags or shoddy, or refuse substances. It is hoed in the summer once, or twice if necessary. Directly the berries are large enough the bushes are picked over, and the largest are sent to market, when they make from 3*d.* to 3¼*d.* per lb., or even more at the beginning of the season; but the price soon falls to 2*d.* and 1½*d.* per lb., and even to 1¼*d.* per lb. An average crop from gooseberry-bushes in full vigour would be between 6500 and 7500 lbs. per acre, and the price between 1½*d.* and 2*d.* per lb. Occasionally, when the soil is well suited for these bushes, very large profits and very quick returns are made. The expense would depend upon the amount of the crop, in respect of picking, carriage, and salesmen's charges. The expenses in connection with the cultivation alone would range from 10*l.* to 12*l.* per acre, and all other charges in the case of an average crop would amount to 7*l.* or 8*l.* per acre. There is a very great demand for this fruit for bottling and preserving, as well as for eating. Gooseberry-

bushes are liable to be attacked in the early spring by the larvæ of an insect known to entomologists as the gooseberry sawfly (*Nematus Ribesii*). To prevent this, it is desirable after an attack to dig quicklime, or lime-ashes or soot, close round the bushes in the late autumn. Syringing with soft soap and soda and water has been found efficacious. Sprinkling with powdered hellebore also is effective, but it is dangerous to apply this when there is fruit on the bushes, as hellebore is a deadly poison.*

RED CURRANTS.—These bushes are propagated in the same way as gooseberry-bushes, from cuttings put in a nursery. The length of the stem can be regulated by the number of "eyes" retained on the cutting; but it is generally better to let the stocks be short. Bushes may be taken out from the nursery after the second year, and put 5½ feet apart, or 6 feet if standard trees are planted with them. The distance at which currants and gooseberries are put, whether 5½ feet or 6 feet, must depend upon the quality of the soil to some extent. Currant-bushes must be kept cup-shaped, and the terminal shoots should be pruned to lengths of from 6 inches to 9 inches, according to their vigour. Laterals should not be pruned away, as in gooseberry-bushes, but cut back, so that spurs may be formed, upon which the fruit is grown. The best sorts are the Scotch, the Imperial, Red Dutch, and the Raby Castle. There is a kind of red currant known as the Queen Victoria, whose bunches and berries are exceedingly large and fine. This is particularly adapted for growing in the gardens of farms, as it requires rather more care than other kinds, and the fruit makes a good display. If it were packed in small neat boxes, or baskets, and set off with coloured paper, the fruit would bring good prices in London, Brighton, and other places. Here, again, the garden of the farm may well be utilised. Bushes may be bought of fruit-farmers at from 6*s*. to 9*s*. per 100. An average crop is from 4500 lbs. to 5200 lbs. per acre, and the price runs from 1¾*d*. to 2¾*d*. per lb., while the amount of expense per acre is about the same as in the case of gooseberry-bushes. There is a very large and increasing demand for this fruit for jelly, jam, and for bottling.

BLACK CURRANT-BUSHES, as has been said, require a deep, moist soil. They are easily propagated by cuttings. Care should be taken not to cut these too long, nor to remove the buds, as the bushes should have very short stems or stocks. In fact, in most cases black currant-bushes do not grow from a

* See 'Manual of Injurious Insects, and Methods of Prevention,' by E. A. Ormerod. Sonnenschein and Allen, Paternoster Square.

single stem, as in the case of gooseberry and red currant-bushes, but are stocks close to the ground. As the fruit comes on seasoned wood of the previous year, the young wood requires to be pruned away. After the first year or two no shortening of leading spurs is required, and the pruner need not be afraid of cutting hard, at least when the bushes are on kindly land. Bushes can be purchased of fruit-farmers at from 6*s*. to 9*s*. per 100. The cultivation and manuring are exactly the same as for gooseberries and red currant-bushes. The best sorts are: Naples, the Green Bud, Baldwin's, and Lee's Prolific. There is a sort called the Prince of Wales, which has large berries and comes later than the other sorts. This fruit occasionally pays remarkably well. In very hot seasons the berries are apt to run off, especially if there is not much natural moisture in the soil. An average crop would be about 2800 lbs. per acre, and the average price 3*d*. per lb. Expenses of cultivation, picking, packing, carriage, and commission upon an average crop would come to about 17*l*. per acre. This fruit always is in great demand for jam, jelly, lozenges and, as some say, for port wine.

Raspberries are grown upon "canes" or stems, pulled up from established stocks in the autumn, and put into well-ploughed or deeply-dug ground, in rows 5 feet apart, and 15 inches in the rows. The cultivation afterwards is like that of gooseberry and currant plantations, except that some planters use horse-hoes between the rows of canes. Raspberry canes cultivated on a large scale are not staked, but are left to support themselves, and are cut down in the late autumn to about 3 feet in height; the older wood is cut away, and all superfluous young wood. They require a fairly good soil, not too porous, as they do not bear drought well. The Red Antwerp and Fastolf are usually planted. Carter's Prolific is also coming to the front, having large well-coloured fruit. An average crop is about 3000 lbs. per acre, and the price about 3*d*. per lb. There is a great demand for this fruit for jam, and raspberry vinegar, and for many concoctions and confections. It may be said here that many of the numerous non-alcoholic beverages so much in vogue, and steadily increasing in favour, are flavoured with, or partly composed of, fruit extracts. Raspberry culture necessitates a good supply of women for picking the fruit, as the canes want looking over many times. Raspberries are largely grown in Kent. Some growers have from 20 to 40 acres. They are picked into galvanised iron pails, and sent to market in tubs, with lids to them, because their juice easily escapes. Some of the finer fruit is sold for dessert purposes, and should be carefully packed in small baskets, or better still, in small earthen crocks, holding from 7 to 14 lbs. These are much used for

raspberries and strawberries by fruit-growers in Derbyshire and other Midland and Northern counties, and are cleaner, and retain the juice much better than baskets, and should be adopted in Kent and other counties where these juicy fruits are produced, for sending small quantities of fruit to market.

We have much to learn in the modes of packing and arranging fruit. Those who intend to grow fruit extensively would do well to go to Covent Garden Market, and notice the packages of the French and other importers of fruit, which are much smaller and neater, and, it must be said, far cleaner than the "sieves" and "half-sieves"* in which much of the English fruit is packed; many of these are dirty in the extreme, and wholly unfit to put fine fruit in.

STRAWBERRIES may be profitably grown in most of the lighter clays, also upon loams, and upon the better sandy soils. Upon loams and good descriptions of clay, the plants will continue to bear well and pay for several years. Upon some soils they will only pay for three or four years. In parts of Kent, upon the London Clay, and Greensand, they will last for six or eight years. They are propagated by runners taken from the best plants directly the fruit is picked, and are put in a nursery, and transplanted from thence in the autumn. Or the runners are left on the plants till the autumn, by which time many have thrown out roots; these are cut away and put at once into the ground in rows, 30 inches apart, with a distance of 18 inches between each plant. Some put the plants 30 inches apart each way, or 3000 plants per acre, so that the ground between may be horse-hoed. Early potatoes may precede strawberries; the land should be well manured and deeply ploughed, and subsoiled if necessary. Just before the fruit is changing colour the ground is covered with rough farmyard-manure or litter, laid all round the plants, to keep the fruit from the dirt, to stimulate the growth of the plants, and to retain the moisture. Picking is done by men and boys very early in the morning, and necessitates a good supply of labour. Women pack the fruit for dessert in punnets, which are put into deal boxes, holding five dozen. In some districts the best fruit is put into earthen crocks or pots. Inferior fruit is put in tubs, and sent to jam markets. For this there is a very extensive demand. The average price of the fruit is about 6*d.* per lb. An average crop would be about 3000 lbs. per acre. Frequently as much as 5000 lbs. have been grown per acre. Keen's Seedling, Princess

* Half-sieves are generally used for gooseberries, currants, and cherries in Kent, and the weight is made up to 24 lbs. for currants and cherries, and 28 lbs. for gooseberries. Raspberries are sent in tubs holding ½ cwt. In other counties various sized baskets, called "pots" in some places, are used.

Alice, Dr. Hogg, Refresher, La Grosse Sucrée, Elton Pine, Eleanor, Comte de Paris, Sir Joseph Paxton, are among the best for field purposes. It is curious to notice how little attention is given to strawberries in the ordinary farm-gardens. The bed, in all probability, has not been changed for many years, and is a thick mass of roots and runners, instead of having been moved every four or five years. The fruit may be profitably grown upon banks and side ground which it is difficult to cultivate. It always meets with a ready sale, either raw or made into jam. There are fruit-growers in Kent who have from 80 to 120 acres planted with strawberries.

FILBERTS AND COB-NUT-TREES are grown from suckers or spawns taken from old trees, or pieces cut from the tree, as some prefer, and put in a nursery. In two or three years they are planted out about 13 feet apart, or 257 trees to the acre. A tolerably light soil is best for them, although they thrive remarkably upon the Atherfield Clay, in Kent, which is heavy and adhesive. They also do well in what is termed in Kent "stone-shattery" land. It is necessary that they should be in a position sheltered from the prevalent winds. Standard apple- or plum- or damson-trees are usually put with them in Kent, and currants and gooseberry-bushes are set between the rows, which are taken away when the nut-trees attain a good size. After four or five years a little crop may be expected, and after eight years they will yield a good quantity. The ground is dug in the winter with a three-pronged spud, and hoed once or twice in the summer. Rags, fur, or fur waste, shoddy and refuse manures are applied, not very lavishly. From one and a half to two tons of rags or of shoddy every other year form a sufficient dressing. Pruning requires great skill and care to keep the trees in cup-shape, with the inside as clear as possible. Every branch is examined by the "tree-cutter," who leaves the finest young wood, and cuts away the older and coarser branches. In height, full-grown trees are about 6 feet. Cob-nuts are more cultivated now than filberts, as the nuts are much larger and are more saleable. Owners of land, or tenants with long leases and agreements for compensation, might plant nut-trees to great advantage in places where the soil and situation are suitable. These nuts are packed in ordinary sieves, like other fruit, and consigned to salesmen in London, and are in great request, making from 7*d.* to 1*s.* 4*d.* per lb. An average crop is about 8 cwts. per acre. A demand for cob-nuts has arisen in America, and it is likely that as the nuts produced in that country have not the same flavour as the English, this will assume important proportions.

APPLE-TREES are planted either upon grass-land or in plan-

tations upon cultivated ground, with fruit-trees or bushes under them. In Kent filbert- and cob-nut-trees are frequently put under apple-trees, and sometimes gooseberry- and currant-bushes are set between the filberts. There is not much difference between the yield of apples upon grass-land and plantation, or cultivated land. Some hold that the fruit grown upon grass-land is more plentiful and of better colour and quality; while others say the same with regard to the fruit produced in plantations. Apple-trees require a fairly good soil and a deep subsoil. They will not do well, for instance, upon land with a depth of a few inches upon chalk, nor with a gravelly subsoil, nor upon clay with an undrained, impermeable substratum.

The aspect of the orchard or plantation should depend upon local circumstances. It should not be too much exposed to the prevalent wind, and a sheltered situation is desirable if it can be obtained. Protection from the east wind is thought advisable, as it generally happens that a cold wind prevails from this quarter in the early spring, and checks the development of leaves and blossoms and encourages the increase of aphides and other injurious insects.

Standard apple-trees are raised from crab-stocks, grafted with scions of the required sorts; or from stocks raised from the pips of apple-trees, having hard clear wood, and grafted with the sort required. Crab-stocks are the best. Grafted stocks are fit for planting out when they are from four to six years old. In selecting standard trees for orchards or for plantations, preference should be given to those which have long stems. These ought to be at least 6½ feet from the fork to the ground, so that the branches are out of the way of cattle in the former case, and well above the under fruit in plantations. Apple-trees are planted about 30 feet apart each way, which gives forty-eight trees per acre, when bush fruits are to be put with them; and 24 feet apart, or 75 trees per acre, upon grass-lands; but the distance must be varied in a degree according to the soil and especially to the sorts planted, as some sorts have a more luxuriant and widely-extending habit of growth than others.

Planting should be done early in November. It is most important that the trees should be well established before the frosts set in, and the practice of planting in the winter or in the spring cannot be too much deprecated. Holes should be dug at least 3 feet 6 inches in diameter, and the subsoil should be loosened by the spade or spud to a depth of 2 feet. Care must be taken that the tree is not put too deeply in the ground. Three or four strong branches are enough to form the heads of standard trees. All other shoots must be removed. After this they will require very little pruning, but should just be looked

over every year or two, and any superfluous shoots cut away, to keep the middle of the tree from being crowded by crossing or interlacing boughs. Stakes must be put to the young trees at once to prevent them from being moved by the wind; the trees must be protected by wisps of straw or rags, from injury by the cutting of the strings tied round them, and should be carefully examined every year to see that the strings are not too tight. Protection from cattle, sheep, and rabbits, is most essential. Not half enough attention is paid to this and other details. If a tree is barked by animals in the least degree, it generally cankers and is unhealthy. Where no cattle are grazed, cages of

Fig. 1.—*Illustration of a protecting Fence to a Fruit-tree.*

galvanised wire of a fine mesh put round the trees about 4 feet high and 8 inches in diameter, at a very small cost, will serve to keep off sheep and rabbits. A fence against cattle and horses may be made by driving split fence-rails cut into "slats," or lengths of 8 feet, and $1\frac{1}{2}$ to 2 inches in thickness and width, into the ground, and fastening them at the top with braces, according to the appended figure (Fig. 1). The pieces should be creosoted, as all posts and parts of fencing that go into the ground upon farms should be, and with care they will last pretty well until the tree is out of danger. Good trees can be purchased at about 4*l.* 5*s.* per 100; but fruit-planters should not mind a little

extra cost to ensure good trees of the sorts desired. They must be careful to buy only of respectable nurserymen, or of fruit-growers of standing, and should require full guarantees. The cost of planting, staking, and fencing would be from 4*l.* to 8*l.* per acre. In plantations the trees only require to be protected against rabbits by cages of galvanised wire-netting. The best manure for apple-orchards is farmyard-manure laid round the trees, or manure from sheep, cake or corn fed. Superphosphate, bones, nitrate of soda, and potash may be occasionally used with advantage. Rags, fur waste, and refuse manure are used in plantations. As to the sorts of apples much must depend upon the locality. As a rule, however, the following may be planted:—For cooking purposes, the Early Julien (ready in August); Keswick Codlin (September); Manx's Codlin (September); Lord Suffield, a famous apple (September and October); Cellini Pippin (September). The Ecklinville Seedling, Old Hawthornden, Stone's Apple, or Loddington Seedling, New Hawthornden—a capital apple, follow on in November; and for the winter months, keeping up to the spring, there are none better than the Blenheim Orange, Northern Greening, Lady Henniker, Golden Noble, Lord Derby,—a magnificent apple, Winter Queening, Grenadier, Wellington, Warner's King, Norfolk Beaufin, and Gooseberry Pippin. Among dessert apples, the best and earliest is Mr. Gladstone, a new and beautifully-coloured fruit, ripe in August. The Red Juneating, the Early Strawberry—a perfect picture, and the Red Quarrenden, also handsome, are ripe in September. For September and October the sorts would be the Worcester Pearmain, one of the most brilliantly-coloured apples that can be seen; the Red Astrachan, a lovely combination of red and white; and the Summer Nonpareil; and for keeping, the Ribston Pippin, Cox's Orange Pippin and the Margil, both these last being of exquisite flavour, exceeding that of the American New Town Pippin; Court of Wick, Claygate Pearmain, Mannington Pearmain, King Pippin and Blenheim Orange, Gascoyne's Seedling and the Golden Knob. Some of these, notably Lord Suffield, Stones and Keswick Codlin, come into bearing after a year or two. In ten years there would be a good return from most of the trees, if they had been well-selected, well-planted, and properly managed. Half-standards are sometimes put in plantations. These trees should be formed by working upon a stock known as the Doucin, which exercises a dwarfing influence upon the habit of growth, and causes early fruiting. These stocks are worked close to the ground, whereas, in the case of standards, the crab- or apple-stocks, grown from pips, are worked standard high. The trees may be allowed to grow up with a single stem as high as it is wished, and a head formed as in standards; while the side growth should not be cut

away, but pruned, or tipped, and its growth regulated according to fancy. The advantages of these, both for gardens and plantations made by tenants, are that they come to fruit quickly, that they may be set much more closely together, and are less liable to cankered disease, and that the fruit is finer. Their cost is about the same as that of standards, and they may be set 16 feet apart each way without any fear of crowding, if they are warranted to be upon the proper Doucin stocks. For gardens apple-bushes are coming into general fashion and high favour, inasmuch as they come into bearing in about three years from the grafting, and remain bushes without hacking and excessive cutting. For these the true English Paradise stock, of dwarfing

Fig. 2.—*Sketch of a Margil Apple-bush.*

nature, is used and grafted close to the ground. Bushes of this kind can be put anywhere in gardens, from 7 to 10 feet apart, and are things of beauty in leaf, in bloom and in fruit. A plot planted with bushes of various kinds of apples is as pretty as a variegated flower-bed, when the blossoms are out, and even prettier when the fruit is ripening. A sketch of a Margil * apple-bush, in my own garden, is given here as an illustration of the shape of a typical bush. This is only four years

* The Margil is a beautifully-coloured apple of Ribston Pippin flavour. Dr. Hogg says, "It is one of the finest dessert apples, a rival of the Ribston Pippin, exceeding it in juiciness, and being a better size for dessert."

from the graft, and has thirty-one apples upon it of fine size and lovely colour, and bore half this number last year (Fig. 2). That these apple-bushes are profitable goes without saying, and it is believed that they would be immensely profitable if cultivated upon a large scale, either by themselves or with gooseberries and currants. They are suitable for tenants, as paying at once, bearing removal; in fact, being benefited by being lifted occasionally. Bushes of this kind that were transplanted last March were full of rosy apples in October. Very little pruning is necessary for bushes, and they may be cultivated most profitably in the gardens of farms, as they take up little space, and their fruit is usually well-grown, and but little attention to them is necessary. It would be well if farmers would grub up the wide-spreading, rarely-bearing fruit-trees of common kinds, which take up so much space in their gardens, and in the customary orchards near their houses, and plant bushes or pyramids which would be highly ornamental and certainly profitable. A little pruning and pinching the shoots is all that is required. Their prices range from 1*s*. 6*d*. to 2*s*. 6*d*. each. But planters must have a guarantee from the nurseryman that they are *bonâ fide* Paradise stocks and not crab-stocks. Everything depends upon the stocks in these as in other fruit-trees.

With regard to the demand for apples, it is very great and increasing. Within the last few years a demand has arisen even for the most common apples for mixing with other fruit for jam—to serve as "stock" in fact. Dessert apples of good colour and flavour are always most saleable. Consumers of such fruit well know what high prices they have to give for it, even in the most plentiful seasons. In short, it cannot too strongly be iterated that a wide field is open to occupiers and owners of land and the possessors of the humblest garden for the culture of apple-trees according to the best systems; and that by planting well-selected, well-raised trees, either half-standards or pyramids, or espaliers, or cordons, or bushes, a quick return may be ensured.

PEAR-TREES are more delicate than apple-trees; their blossoming is earlier, and therefore at a more critical season, while they do not bear extremely hard winters so well.

Pear-trees are largely cultivated in East Kent and Gloucestershire upon grass and in plantations, and in Herefordshire and Worcestershire upon grass. There is no reason why their cultivation, and especially of the finest sorts, should not be largely extended in all but, perhaps, the most northern counties of England. Fine-grown pears always are in great request, at full prices, at least to consumers.

The methods of planting, of protecting, of the general management, and pruning are very similar to those described in the

case of apple-trees, though the distance between the trees may be somewhat lessened, unless plum-trees or damson-trees are planted between the pear-trees, as sometimes is done by fruit-growers in Kent, where they are set 12 yards apart. Half-standards raised upon Quince stocks may be set much more closely in plantations; and bushes may be set more closely still, and planted with very good results, both in large plantations and in gardens. Pears can be grown just as well as apples upon bushes and pyramids, and any one may have the finest fruit in his garden, in the garden of the farm and in the fruit-plantation, at a small expense, with but a little attention, and quickly. The old saying that one "plants pears for his heirs" is no longer applicable. For bushes, well-selected Quince stocks are grafted close to the ground. For standards, clean pear-stems are grafted at standard height. In America pears are extensively grown upon bushes. Some time ago an account was given in an American paper of the return of a dwarf-pear plantation, which was 120*l.* per acre, at ten years old. The best sorts of pears for ordinary culture are Doyenné d'Été, Chalk (July); Lammas, Windsor, Caillot, Rosat, Bellissime d'Automne (August); Williams' Bon Chrétien, Yat, Bergamot, Hessle—a very prolific pear, Marie Louise, Eyewood (September); Beurré Bosc (October); Beurré de Capiaumont, Duchesse d'Angoulême, Rondelet, Catillac, Bishop's Thumb, Broom Park. For pyramids or bushes, the following sorts are suited:—Doyenné d'Été, Beurré Giffard, Beurré d'Assomption, Souvenir du Congrès, Gratioli of Jersey, Beurré Superfin, Beurré Hardy, Doyenné du Comice, Pitmaston Duchess, Fondante d'Automne, Winter Nelis, Olivier de Serres, Easter Beurré, Beurré Rance. For the farm-garden the best kinds of pears that might be grown, either on standards, pyramids, or bushes, or espaliers, are the Souvenir de Congrès, Beurré Clairgeau, Louis Bonne of Jersey, Durondeau, Beurré Superfin. These are remarkably fine pears, and may be sent to market by the dozen, and will always find a sale at good prices.

Pears and apples that ripen in the winter require to be carefully kept in a dry well-ventilated chamber, with an even temperature, and laid upon stout laths set an inch and a half apart to allow circulation of air. A series of trays placed one above the other, running in grooves, is the best form, as they can be pulled out and the fruit examined. They should frequently be examined, and sent to market when ready.* It would pay

* It is too much the custom for large fruit-growers to send their apples and pears to market straight from the tree, and then they wonder that they make poor prices. No doubt they are wise in sending off the common kinds, for which there is generally a ready sale for smashing; but it is a sacrifice to consign fruit

well to consign brilliant-coloured and, indeed, all the finer fruit, especially that grown on bushes, in small, well-made, bright-looking baskets or boxes, set off with pink or white paper; and for this kind of fruit, as well as for all superior fruit of every kind, contracts should be made, if possible, to supply it directly to the retailer.

PLUM-TREES AND DAMSON-TREES are grown on grass or in plantations. Standards are set 15 feet apart each way, which would take 193 trees per acre. In very strong land they are set 18 feet apart. In Kent they are frequently put between apple- and pear-trees, and are removed when these trees get large. Plum-trees and damson-trees are often set with fruit-bushes. This is a kind of plantation which tenants with long leases might undertake without much risk, as the plum-trees will come into profitable bearing after five or six years, and the damson-trees after four or five years. Plum-trees are raised from common plum stocks, grafted or budded with scions of the kind required. What is known as the Brussels stock is used for producing large quick-growing trees; the Pershore plum-tree, grown so largely in Worcestershire, which can be raised from cuttings, is also a good stock. For bush and small pyramids, the grafts or buds are worked upon the *Mirabelle petite*, a stock having a bushy and prolific habit. The famous Farleigh or Crittenden damson, which is so wonderfully productive and profitable, can be easily raised from its own suckers or spawns without grafting or budding. Nurserymen, however, hold that better trees are obtained quite as quickly by grafting upon ordinary stocks; the stems of these are clean, and free from the disfigurement caused by cutting away shoots from the natural stocks.

Plum-bushes may be planted in plantations with gooseberry- or currant-bushes with immense advantage. Wind does not injure them. They bear fruit abundantly. They may be planted thickly; the fruit is of fine quality, and can be picked without ladders, or breaking the trees. When the superior advantages of fruit-bushes of all kinds are fully realised, we shall see a great revolution in English fruit-culture. The American fruit-growers are largely adopting this system, and gardeners who grow fruit for market have found out its superiority over the old method. Good sorts of plums for plantations are the Early Rivers, Early Diamond, Blue Prolific,

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that would keep well with care until February and March, to salesmen in October or November. Some Kent fruit-growers keep apples and pears in oast-houses, which are fairly suitable. All large fruit-growers who wish to make the full value of their fruit, must arrange proper places for storing it until it is properly fit for use.

Perdrigon,* Early Orleans, Corse's Nota Bene, Dauphine, Belgian Purple, Washington, Prince of Wales, Prince Engelbert, Pond's Seedling, a magnificent plum, Coe's Golden Drop, Belle de Septembre. The best damsons are the Farleigh or Crittenden's, the Shropshire and the Prune. These do not last nearly so long as apple- and pear-trees, and come into good bearing at from six to seven years old, when planted upon good, well-drained soil. They will thrive upon loams, clay-loams, the lighter marls and clays, and should not be planted deeply, as their roots do not go down far into the ground, but run along the surface. Nor should they be put in a situation much exposed to the wind, as the branches are brittle, and break off easily when laden with fruit.

PLUM- and DAMSON-TREES do not require much pruning. A little tipping of strong leading shoots must be done for a few years, and a little occasional judicious clearing out of the centre in the case of standard trees. Bush trees must be tipped and crossing shoots removed. For pruning standards, and indeed for bushes in their higher branches, there is a capital cutting-machine, now in use on a few farms, made by a village blacksmith. As will be seen in the engraving (Fig. 3), there is a

Fig. 3.—*Pruning Machine.*

sharp oblique knife on one side, and on the other a kind of hook, which has teeth or notches to grip the shoot or branch, while the knife is pressed into it by the leverage of the long handles. These cutters may be 2 feet or 4 feet long, or any length, and it is wonderful what large boughs can be cut off by them. For young trees and bushes no ladder is wanted if this cutter is used, and it is most objectionable to set ladders against young trees. For picking and pruning, a step-ladder should be used when possible.

Plums always sell well. Last year they made capital prices. They are ready when other fruits are out of season and when the foreign season is over. For damsons there appears to be a practi-

* "It is said that the Perdrigon plum, with two kinds more, were first made natives of this soil by Thomas Lord Cromwell when he returned from his travels."—HASTED, '*History of Kent.*'

cally unlimited demand, at 8*s.* to 12*s.* per sieve. Also for Greengages, of which the best sorts are the early Gage, Reine Claude Hâtive, and a late Gage, Reine Claude de Barry. Blecker's Yellow Gage is also an excellent fruit and is always in demand. Although acres of them are planted in East Kent, they are more fitted for the farm-garden or for snug sheltered spots. As they are valuable fruit, to ensure full prices for them they should be packed in small boxes in single layers, and set off with a little fringe of coloured paper, in the same way as they are sent from the Continent.

Cherry-trees yield a handsome return in localities suitable to their growth, as in parts of Mid Kent, near Maidstone, upon the Lower Greensand, and in East Kent upon the loams and brick-earth of the Tertiary soil over the Chalk, where they thrive particularly well, though the situation is high and exposed. As they blossom early in May, they are liable to receive injury from spring frosts. These trees require a dry subsoil, therefore are not suited to heavy clay soils. The ordinary method of obtaining standard trees is to graft upon stocks of the wild cherry, *Cerasus avium.* Standard trees may be purchased at from 1*s.* 4*d.* to 2*s.* each, and should be planted about 30 feet apart, or forty-eight trees to the acre, upon cultivated ground with gooseberry- and currant-bushes under them, and plum-trees may be set between them. After ten or eleven years the bushes should be taken out and grass seeds sown, as cultivation does not suit cherry-trees when they have attained a certain size; or the trees may be planted at once upon grass-land. The plum-trees may remain from twenty-five to twenty-eight years, at which time the cherry-trees will be in full vigour. There is no reason why cherry-orchards should not be made in many English counties. Encouragement should be given in every way by landlords to their tenants to plant them as well as apple- and pear-trees. Pyramidal trees or bushes are formed by grafting upon the Mahaleb stock, *Cerasus mahaleb*, a native of the South of Europe. These are very prolific, and may be planted in the same way, and with as much advantage as apple, pear and plum pyramids and bushes.

Pyramids and dwarf trees of the English red cherry, or Kentish Red and Flemish, should be planted in every available spot, in gardens and in plantations. They do not take much room, and invariably make high prices, because their fruit has a fine subacid flavour, and is peculiarly suited for bottling, drying, and preserving. The Morello cherry also is recommended to farmers for growing against north or west walls, or north heads and sides of barns, or lodges, or stables, while the south and east sides of buildings would be occupied by plums,

figs or peach, or nectarine-trees. Morello cherries always sell well for making cherry-brandy, and for preserving, and should be sent for sale in cardboard boxes, with two layers in each, the stems being cut to about half an inch in length.*

The best sorts for standards are the Early Purple Gean, Early Rivers, Adam's Crown Heart, Early Frogmore, Knight's Early Black, Kentish Bigarreau or Amber Heart, Elton Heart, Waterloo, Black Heart, May Duke, Black Eagle, Flemish, Turkey Heart or Turk, Florence, Kentish Cluster or Crown, Morello. These ripen in the order in which they are given above. Those that are best for pyramids are the Early Purple Gean, Belle d'Orleans, May Duke, Royal Duke, Flemish, Kentish Red, and Morello. The three last are hardy, very prolific, and their fruit always is in great demand. All cherries are most saleable. The importation of cherries from France, Holland, and Algiers has ceased when English cherries are ready for market. They sold remarkably well last year, having made from 14*s.* to 30*s.* per sieve of 48 lbs. A landowner in East Kent, who has planted many acres of land with cherry-trees, cleared 420*l.* in the last season by the fruit from 7 acres. English cherries are superior in flavour to those grown on the Continent, as indeed most of the English fruit is, and they are much appreciated by gourmets. As has been said before, they ripen when Continental cherries are over, and at a time when there is not an abundant supply of fruit in Paris, Brussels, and other cities. The same applies to plums and to soft fruits. Seeing that there is no duty upon fruit imported into France, and only 5 per cent. *ad valorem* upon fruit imported to Holland, and 10 per cent. in the case of Belgium, surely a trade might be established with those countries. The Kentish Railway Companies have stated that they are willing to give facilities of transport and a quick service, and it only remains for enterprising growers to open communications with dealers in the chief cities of those countries.

This concludes the list of fruits that may be grown upon a large scale, the cultivation of which does not entail a great amount of skill or knowledge. There are other fruits whose cultivation could be taken up by enterprising fruit-farmers after a time, such as peaches, nectarines, apricots, figs, and grapes, out of doors, and under glass with or without heat. A great deal of money is made from these by the few who grow them, who make a business of producing luxuries for the wealthy. Judg-

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* Cherries are usually packed in half-sieves, holding 24 lbs. Very fine Bigarreaus and other kinds are sometimes put into quarter-sieves, holding 12 lbs.; but it would well pay to put the very choicest fruit into 2 lb.-boxes or baskets, as is done by the French growers.

ment is necessary in the selection of suitable spots and of suitable sorts of fruits for planting, and special care must be taken that the sorts are true to their names. Planting must be thoroughly well done in every detail, if the best results are desired. This kind of ship is most easily "spoiled for want of a halfpennyworth of tar." Cultivation also must be carried out in a liberal manner, and far more attention paid to packing and setting fine fruit off in the best light than is now bestowed by ordinary fruit-growers. Fine apples and pears should be stored and only sent to market when they are ready for use, in order to make the best prices of them. Above all, fruit-growers must combine and establish a better mode of selling their fruit, in order to get a price more approximate to its real value. Already in Kent some growers have taken steps to form an Association to alter all this, while others have commenced to make contracts with retail shops to supply them directly.

There is an enormous demand for fruit of all kinds, and intending planters must not be frightened either by fear of the foreigner or that the supply will be in excess. Jam-making assumes larger proportions year by year, and, as has been suggested, fruit is also used for flavouring drinks of all kinds, for dyeing, and for making wines. Some idea of the extent of the jam-making trade may be gained from the following, which appeared as an advertisement in a newspaper in Kent, during the whole fruit season :—

"To Fruit-growers, Dealers, and Others. Wanted for Cash—

5000	bushels	Green gooseberries.
5000	,,	Black currants.
8000	,,	Green gooseberries.
2000	,,	Red currants.
500	,,	Common apples.

Address —— Covent Garden, London."

It would be most desirable that fruit-growers should have some conveniences for turning their fruit into jam or jelly, in case of gluts in the market. The process of jam-making is simple, and is understood by most housekeepers. It seems that nothing but a good-sized copper would be required to convert quantities of fruit into jam, which, from its *bonâ fide* character, would certainly hold its own against the manufactured, strangely-blended concoction of ordinary smashers, who use common apples as a foundation. Indeed, it is alleged that marrows, turnips, and other vegetables are used by some of the smashing fraternity ; and flavoured, according to taste, with raspberries, gooseberries, and currants. A landowner in the Midland counties having planted hundreds of acres of land with fruit-trees has,

with admirable foresight, put up an apparatus for boiling down fruit, if the prices offered for it when raw do not suit his ideas.

Fruit-growing is a most interesting and engrossing occupation, and, taking an average of seasons, is also most profitable. As has been shown, it may be commenced in a small way,—in the garden of the farm, and gradually extended as circumstances may warrant. The chief objection to its adoption hitherto by tenants—that so much time elapsed before any return could be made—has been removed by the introduction of trees of dwarf and early fruit-bearing habit, in the shape of half-standard pyramids and bushes as regards apples, pears, and plums; and a tenant protected by a long lease and by assurance of compensation for improvement, which most landlords would be glad to give in these days, may venture to cultivate these fruits. In the case of other fruits, it has been shown that in two or three years the bushes will begin to bear, and soon become remunerative.

III.—*The Poultry of the Farm.* By the Rev. W. J. Pope, Godmanstone Rectory, Dorsetshire.*

Poultry-keeping is a subject which has lately received an unusual amount of serious attention; to make the most of everything must be the rule on a farm; to waste nothing should be the endeavour of every housekeeper. In these trying times we cannot afford to despise small things; not that poultry-keeping could ever have been justly styled or deemed unworthy of attention, but now we specially want all our wits at work. Such a competition is going on between us and the foreigner, that all our resources must be looked into carefully, or the weakest will soon go to the wall. Our energies must be employed to prevent the loss of anything, either worth keeping or capable of conversion into something useful and valuable; and so the stray corns on a farm otherwise wasted, and the scraps from a house are to be duly utilised by poultry-keeping. But apart from the £ *s.* *d.* aspect of the matter, much might be said of the poultry-yard as a school for the youth, wherein he may acquire habits of regularity, or carry on such a cultivation of the eye as may enable it to take in readily the condition, points, and requirements of the live-stock of the farm; or even where people of all ages may find a profitable amusement during what otherwise might be idle hours; but my instructions tell me to endeavour to be plain, practical, and concise, and the import-

* This paper has been published in pamphlet form by the Royal Agricultural Society, price 6*d*.

ance of the subject I am introducing is proved by the Council of the Royal Agricultural Society of England regarding it as worthy of their notice. Therefore let us suppose that, circumstances and surroundings having been well weighed, the conclusion is "some fowls are wanted." Now arises the difficulty of selecting the most suitable variety.

Generally speaking, Mongrels do not go down easily with us. "Some sort about them" is a recommendation for any kind of live-stock, and what is a mongrel if not something "mixed" but not "fixed"? My idea is, that after the first cross we can only consistently use the term Mongrel until we have a variety so far established that the produce shall resemble the parent-stock. Sometimes we see mixed breeds described as "barndoor-fowls," to the annoyance of those who, with me, would call "a spade a spade;" and I have yet to learn that it is either necessary or desirable to keep a stock of nondescripts, whilst so many excellent varieties and "first crosses" can be obtained. In making a selection, the great consideration will be, what is chiefly desired? 1. Eggs? 2. Chicken? 3. Chicken and eggs? 4. Appearance?

I. When the vast importation of eggs is remembered, the importance of a home-supply is recognised. We all like a freshly-laid egg, and the way to get it is to know when and where it came to light. There is such a doubt about foreign eggs, that just now purchasers are even particular about their colour; but leaving that question, I turn to our own non-sitting breeds, and without hesitation I introduce—

The Minorcas—on account of the many and large eggs they produce, whilst their dark glossy plumage looks well either in a farmyard or in a small enclosure. They are, moreover, stronger than the Spanish, which have suffered in more than one way by the absurd demand of fashion for immensely large white faces. I may mention that this year we placed four Minorca hens and a cock at an outlying barn; from February 6th to June 6th we took 324 eggs. Others were probably stolen or lost in the hedges; one dozen of the eggs weighed 2 lbs. 2½ oz. Blue Andalusians closely resemble Minorcas, in fact may be regarded as an off-shoot or a variety not yet quite fixed, so many chicken "sport," or come black or white.

Leghorns, either Brown or White, are excellent layers, and pretty useful fowls.

Hamburgs.—Gold-Spangled and Pencilled, Silver-Spangled and Pencilled, and Black. The latter variety has lately gained ground; the Spangled are larger than the Pencilled, and all are neat, nice, and noisy—consequently useful as well as ornamental about a house, being good night alarmists.

II. Chicken being wanted, we must have Dorkings or Dorking

blood; for shortness of leg, solidity of body, whiteness of flesh, a good honest "cut-and-come-again breast," early fitness for the market, and "something for your money," nothing beats the Dorking. The chicken may be somewhat delicate, and so there is much to be said for the first cross, and the best will be produced with the Brahma or the Game. Brahma-Dorking chicken are hardy, and give satisfaction on the table. "Cuckoo" Dorkings are not largely patronized. The "Coloured" and the "White" are better known. The latter are smaller, and must have rose or double combs. All Dorkings must have five clearly defined toes on each foot, and strictly white legs. Many of our principal breeders and judges are now alive to the danger of allowing our fine table-fowls to be handed over to "the fancy," and their excellence to be endangered for the sake of a feather. Undoubtedly, breeding for dark plumage has resulted in "sooty"-legged Dorkings, and it is to be hoped that our great Agricultural Societies will oppose and stamp out the blot by only recognising the strictly white-legged bird. Dorkings are better layers than they are generally supposed to be.

"Scotch Greys" are becoming better known in the south. They are good either in the farm-yard or enclosure.

III. For the production of chicken and eggs, Dorking cocks mated with Brahma hens are desirable, as such hens lay in the cold weather.

Plymouth Rocks are a new variety, much patronised, and promise to be good layers as well as good eating, although their yellow legs may not recommend them for "boiling." The chicken are hardy; eggs not particularly large.

IV. On the point of appearance, I will only say that it is a pity to sacrifice our best table varieties, whilst so many beautiful breeds afford a chance of indulging the fancy.

When fencing is a consideration, and as specially adapted for confinement, Brahmas, Cochins, and Langshans are unequalled. A low wire restrains them; they are quiet, contented, good sitters, and lay in cold weather; but they cannot claim "the enviable distinction" of first-class table-fowls.

The French breeds have their admirers, although the Houdan has not fulfilled the promise given.

The Polish—of several varieties—are fairly useful, and much to be desired by those who love a top-knot.

The Malay is considered good eating, but a savage. Other breeds might be mentioned if they could be recommended as profitable for the farmyard or cottage; and certainly Bantams of much beauty and very-varying colours may find a place in the stable-yard.

Having decided on our breed of fowls, we put ourselves in the hands of some breeder of good repute, from whom we obtain at a moderate price well-bred, but not exhibition birds, likely, however, to breed really good chicken.

N.B.—Treat advertisements with caution. Prize-winners are not necessarily the best for stock purposes. Dorkings, especially, suffer from frequent exhibition.

Let us also invest in a few sittings of eggs, for which we can afford what may seem to be a large sum; but change of blood is a grand point, and eggs nowaday, packed in moss and paper, or in regular egg-boxes, travel safely and far, and hatch out so very fairly that the experiment is worth a trial. But let us look round to see that everything is ready for the reception of our fowls. Those to enjoy the run of the farmyard will roost in the stalls over the cattle, or in a shed. Hurdles must be placed under them to catch the droppings and prevent annoyance to any one or anything below. Heavy fowls should not roost too high, as they come off the perch with such a rush. If a regular and well-arranged poultry-house is available, it has a floor which can be and should be swept and kept clean. Perches are fixed to be clear of each other, and are broad and flat enough for the fowls to roost comfortably upon them. The two great evils of farm poultry-houses are filth and badly-contrived perches; and so, having no choice, the fowls become unhealthy or "crooked-breasted," and could do better if left to seek their own quarters on the beams of a shed or even in a thick tree.

Coddling is to be avoided, but, N.B., ventilation, attention, and decent care are necessary.

Egg-boxes are placed away from the perches, to ensure quiet. Their size will depend upon the variety of fowls kept. A long continuous line of nests is likely to lead to disturbances or breaking of eggs; and success is often more attainable in old bee-pots turned upside down, and hung in the corners of the house, than in smart-looking boxes divided into nests, but not carefully constructed to ensure privacy for the laying hen.

Artificial nest-eggs are desirable.

The foregoing remarks apply to all places used for poultry. Cottagers, as the rule, are careless about the provision of cinders and other things easily obtained, in which fowls delight, and which tend to cleanliness, comfort, and health.

The number of hens to each cock will depend upon the breed, *e.g.* a game cock may run with from eight to ten, whilst a Dorking should only be allowed five or six. No confidence can be placed in old cocks; they drive off the younger and more active birds, and often mope during the cold winds of March—

a most important season. Old hens are also undesirable; therefore a good stock of pullets should be obtained every year, as they lay earlier and better than hens. If possible, and if first-crosses are chiefly cultivated, a cock and some hens of pure breed should be placed at a shepherd's or some outlying cottage.

As regards feeding, fowls in confinement require more food and attention. They do well on three meals a-day; the first being one of soft food, soaked scraps, meal, potatoes, &c., given hot in winter and occasionally peppered; next a feed of maize; and for supper, as much light wheat as they will clean up: no waste of food should be permitted, it is bad for the birds as well as for the book. A mangold or green stuff will be appreciated, also old mortar rubble; clean water must be within reach. When March winds prevail, shelter should be insisted on, or laying is checked, and hens become "blackheaded" and out of sorts.

Farmyard fowls running amongst the straw or cattle require but little feeding and give but little trouble. One early meal of "tail-corn" will suffice, but about March many hens begin to show a disposition to sit or become "broody." Now look out for squalls. I find no plan answer better than sitting-boxes, every hen being compelled to occupy her own nest and to leave her neighbour in peace. Our hens are taken out at the same hour every day, and after about a twenty minutes' run in pens prepared for their feeding and dusting, they are returned to their nests, and it is surprising how soon they settle down and allow themselves to be quietly handled. We generally put clay at the bottom of the nests, or sprinkle the eggs occasionally; a little carbolic at the edge of the nest, or Hardeman's beetle-powder, is good for the hen because bad for the insects. A hen will cover from eleven to fifteen eggs, according to her size.

Suitable boxes may be knocked up very cheaply: it matters not how rough, if the sides and partitions are close enough. A cover composed of strips of wood keeps the hens in peace and lets in the air.

A stock of coops should be forthcoming on a farm every spring, as each winter they ought to be carefully washed, disinfected, and stored ready for use. The old-fashioned coop with a slanting roof to shoot off the wet, and with strong upright bars in the front, answers every purpose. It is well to have a close front wherewith to shut up securely by night, and the same board when let down may do for feeding on by day. A "feeder" to fit the coop is easily and inexpensively made of wood and wire; into it the little chicken run to pick up the more dainty morsels which otherwise might be devoured or trampled on by the hen or carried off by sparrows. When

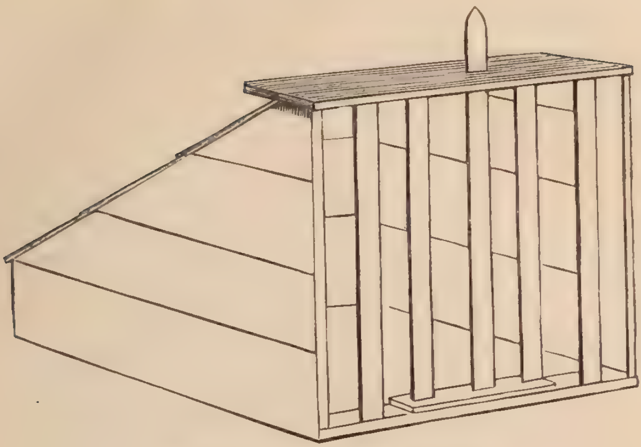


Fig. 1.—*Front View of Coop.*

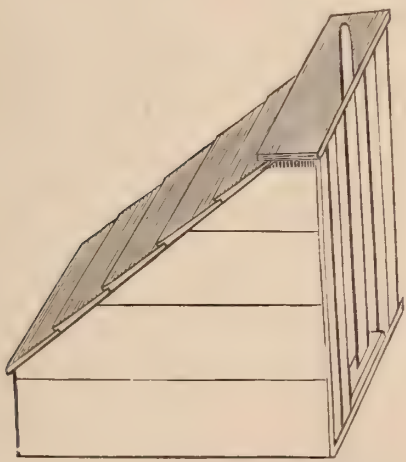
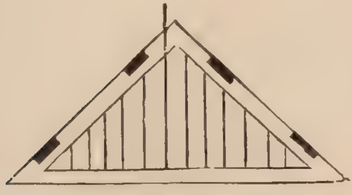


Fig. 2.—*Side View of Coop.*



Figs. 3 & 4.—*Illustrating cheaply-formed Coop, not blown over easily by wind, and affording safety for young chicken, inasmuch as the hen cannot so well tread on them.* (For Fig. 4 see p. 110.)

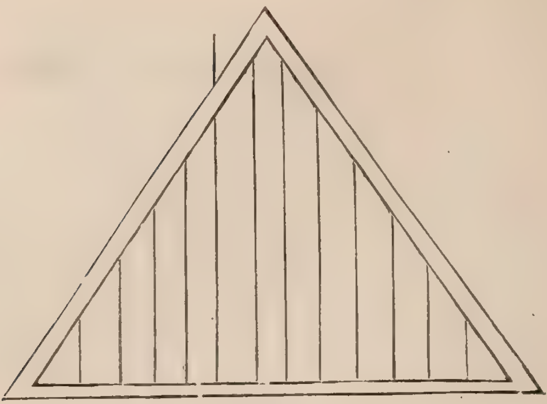


Fig. 4.

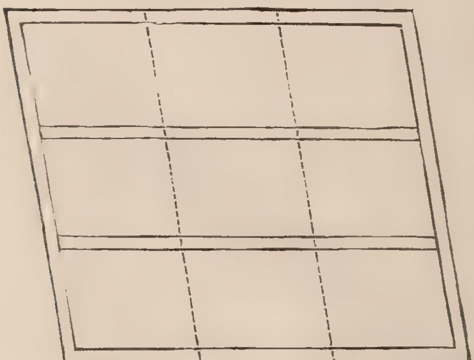


Fig. 5.—*Side elevation of Skeleton on which three nine-inch boards are to be nailed.*

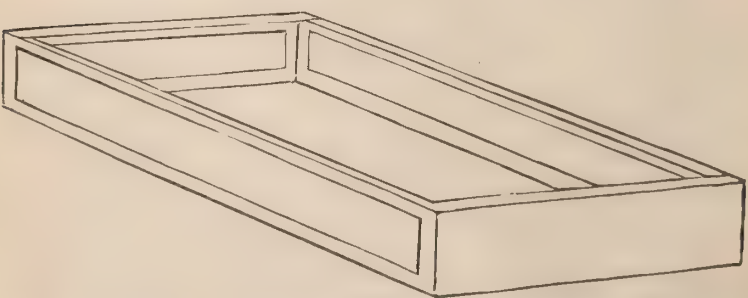


Fig. 6.—*Feeder, to be covered with wire through which Sparrows cannot pass. Sides either of wood or wire.*

strong enough, the chicken can be allowed to run out, by simply moving the feeder a few inches from the coop. Where there is a covered shed, coops may cheaply be formed from old boxes; but if expense is not of primary consideration, excellent coops and appliances may be obtained from many firms (see annexed illustrations).

The coops should be frequently moved.

Feeding young chicken should begin in the early morning and be carried on at regular intervals during the day. Bread soaked in milk I find as good as anything, then a few groats and meal, chopped meat and potatoes; soon they enjoy wheat, and there is nothing better for them. When stronger, maize is liked; it suits them well, and is not portable enough for the sparrows. If not too numerous, the broods should enjoy as much liberty as possible; the luxury of scratching up worms and insects will be of great benefit. If fed as I have described, with regularity and discretion and not turned sick by a superabundance, chicken, especially Dorkings, are soon fit for the market.

The French are great poultry keepers as well as cooks; they fatten by "cramming;" they caponize; both operations to my mind being needless and cruel: anyhow, I do not regard such operations as likely to pay the farmer or cottager, though they may be worth the consideration of any one who buys up chicken and makes a business of fattening. I prefer to catch up the chicken as they become fit, and then to call in the services of the higgler, or else to send them to market; one or two shots at the London market may not answer. The ups must be taken with the downs. Therefore I would advise the cottager to avoid the mere speculation of sending a small lot so far. Those who send regularly, usually employ a respectable salesman, who does the best he can for his employer, and in this way he often as successfully deals with hens which find their way to him about Christmas as with plump chicken at other times. To avoid trouble, the fowls can be sent to market in large flat baskets, but otherwise they must be killed, plucked, and got ready.

Killing.—I may be excused for now condemning strongly the practice of hanging up several fowls by their legs head downwards, cutting their throats, and leaving them to die at their leisure. After a consideration of the matter all round, I am disposed to think that the best method to be adopted by practised hands, is to strike the bird on the head and immediately to cut its throat, by passing a knife down and cutting upwards towards the roof of the mouth; the stunning blow prevents blood-sucking, and so prolonged suffering, whilst the fowl bleeds freely, and if its wings are crossed, the feathers are

not made bloody; advantages not gained by running the throat through, dislocating the neck, or severing the head from the body.

Plucking or Picking is generally done best when the bird is warm. The way in which it is done considerably affects the appearance of the fowl in the market.

Of Drawing and Trussing, I cannot now say more than mention that here again is an endeavour to learn of the French, who prepare so well, that our old system is likely to undergo a change, and I pass on to speak briefly of

Diseases.—1. How to prevent? Cleanliness, regular and consistent feeding, shelter, change of blood and of position.

2. How to cure?—specially the two great enemies, roupy affections and gapes.

For Roup keep warm, wash head and mouth with vinegar and water, or Condy's Fluid; feed on bread-and-milk.

Gapes are a great scourge, weakening, if not killing. The fumes of tobacco or carbolic have given us the greatest help. A common pipe, stable bucket, a cloth and a smoker, are all that are necessary with tobacco. Place the chicken in the bucket, cover them up, pass in the stem of the pipe, blow in the fumes until the sufferers are heard falling about, then turn them out at once. Repeat in two days. We use boxes and bellows, so that women may operate. We are now trying a bent wire, which, when dipped in alum and camphor, dislodges the worms. When a yard is once tainted, it is more than difficult to eradicate the disease.

Feather-eating and comb-eating are habits which call for death.

Bumble feet, gravel in the foot, are affections to which Dorkings and heavy birds are peculiarly liable. Fomenting and removal of the stone are necessary for relief.

For general use, castor-oil and tonics, such as quinine and iron, should be available. The comb is an index; if it loses brightness and turns either black or white, something is amiss, and then the droppings should be observed. The spiced and prepared foods, *e.g.* Spratt's Food, and "Parrish's Chemical," often prove beneficial.

Space will not allow, or before concluding my remarks I would say something about "incubators" and artificial rearers. I cannot, however, do less than draw attention to the interesting experiments going on and the great improvements already made. It is said that chicken hatched and reared by an "Artificial Mother" are supposed to be more hardy, though I am old-fashioned enough to believe that nothing equals the natural mother for the farmyard or the cottage.

Ducks are so easily reared, and so harmless, or even useful in

a garden, that we may see them anywhere. An erroneous impression has existed that they require a lot of water, whereas they will thrive and multiply if they only have access to a trough or pan sunk into the ground—a swiftly-running stream, indeed, is against their getting fat.

The principal breeds are the Aylesbury, Pekin, Rouen, and the smaller but pretty East Indian and Call Ducks.

The Pekins are very large, but it is a question if they lay as early as the Aylesbury. About one drake and three ducks will prove very prolific. The earliest ducklings are generally hatched under hens. Ducklings require plenty of food. In an ordinary way barley-meal is as good as anything. They should enjoy a good range, and then they throw themselves into skirmishing order and attack the slugs, worms, &c. In some districts the fattening of early ducklings is carefully practised, and proves very remunerative—a pair soon weighing 9 or 10 lbs. Let us bear in mind that size is not everything.

Turkeys are delicate birds to deal with in their early days, and often prove annoying to fowls, therefore they are not so much patronised. The principal breeds are the Norfolk and Cambridge. Large Bronze birds are also esteemed. Chicken are frequently hatched with the young turkeys. Egg, curd and meal will form a good diet for the young birds, then wheat or whole corn. If they survive the earliest stages, they become hardy, going off to find their supplementary food by day and returning at night. About a month's fattening will bring them up to great weight. On the whole, and if the run is suitable, turkeys are decidedly profitable. The American change of blood is doing good.

Geese are chiefly adapted for poor or marshy ground, as they run over and spoil so much good grass; they are very hardy, and after the first month can be almost left to themselves until they are required for fattening, when they are shut up in a moderately dark place. Their food will be meal and whole corn, or a little mangold is sometimes added. Nowadays 20 lbs. is not an extraordinary weight for a goose. The Embden and Toulouse are the best varieties. Old ganders are very irritating to cattle in the yard, otherwise geese are very desirable and profitable on a farm.

Guinea Fowl lead to much worry, as they lay away and injure fowls; but their flesh and eggs will find a place for them somewhere.

In such a limited space for so full a subject I must necessarily have slurred over many notes of admiration as well as of alarm; but let me give one jubilant crow over the spirit moving the agricultural body and authorities to think more of poultry,

for in this fact I see fewer "Poultry Farms" and consequent failures, whilst there is a better prospect of our "table" breeds not being handed over to the mere feather-weight fanciers. The fearful wave of agricultural depression now sweeping this country may lead to legislation and divers changes, it may be to smaller holdings or to large land associations; if so, poultry-breeding will be a great feature of the times.

IV.—*On Green or Fodder Crops not commonly Grown, which have been found serviceable for Stock-Feeding.* By JOSEPH DARBY.

THE climate of the British Isles is so very variable, that it ought to be accounted an extremely fortunate circumstance that there are so many green and fodder crops having claims to the favourable attention of farmers which are adapted to meet a wide diversity of seasons and weather incidents. Some thrive best in dry summers, others in damp ones. Not a few offer advantages in supplying early spring feed or forage, while another class are serviceable by affording a provision of keep for autumn and winter. Some are so naturally affluent in yielding capabilities, that half a dozen heavy cuttings may be taken from them in one year; and the hardiness of a further series, in resisting the most Arctic and rigorous snow-blasts and cold, is their best recommendation for selection.

Do farmers in general sufficiently appreciate the value of this wide diversity in green, root, and fodder crops which offer themselves for their acceptance? Judging by their acts and the ordinary policy pursued in most districts, the reply must be in the negative, there being very few, comparatively speaking, who adopt anything like a wide series of the crops referred to, the majority preferring to limit their consideration to those which can be grown at least cost and are easiest to manage. But the folly of putting all the eggs in one basket is sufficiently illustrated if we recall to memory the great privations and losses which followed the failures of the turnip-plant in the drought years of 1864, 1868, and 1870. The depreciation in the value of flocks after each of these seasons, and the wholesale way in which sheep were sacrificed, caused painful experience, which thousands can never forget. Some endeavoured to obviate the worst accidents of the situation by the lavish employment of artificial foods, but this could only be done at a very heavy expenditure, which had to be kept up for lengthy periods. Those only enjoyed immunity from the fell swoop of the disasters

which then fell on the farming community, who had not directed their sole attention to turnip-culture for providing the winter feeding of sheep and cattle. Those who had the largest acreages of mangold-wurzel, cabbages, gorse, and kohl-rabi suffered least, and were enabled to preserve their stock by the smallest expenditure in the purchase of artificial foods. Similar experience has been derived during three recent winters in which turnips were extensively destroyed by the severity of the weather. In seasons of scarcity, at other periods of the year besides winter, it is an immense advantage to be able to fall back upon thousand-headed kale, purple-sprouting broccoli, green rye, or the early cuttings of sainfoin, lucerne, and Italian rye-grass in spring; on cabbages, vetches, prickly comfrey and repeated cuttings of lucerne and sainfoin during summer; and as autumn advances, on the breadths of thousand-headed kale, cabbages, and kohl-rabi which were spring-sown, together with green maize and still further supplies from the plots or fields giving lucerne or prickly comfrey.

Some of the crops just mentioned are commonly grown, although on a smaller scale than seems desirable. Others, such as lucerne and sainfoin, notwithstanding their being several centuries old, and extensively grown on the Continent, do not appear to be adopted in this country to a greater extent than they were seventy or eighty years since. Then there are the cabbages and kohl-rabi, which, according to Arthur Young, had earlier introduction to field culture in Great Britain than the swede turnip. These have certainly been adopted much more extensively of late years, but only by the best class of farmers, the commonalty having an erroneous impression that they are expensive crops to cultivate, only well adapted to good land and high farming. The same idea extensively prevails in regard to thousand-headed kale and sprouting broccoli, which, although old garden plants, are among the newest in their application to the requirements of the farm. Even prickly comfrey is not new, as it has the reputation of having been introduced into England as early as 1790, and grown in Russia and Circassia long before; but, so far as Great Britain is concerned, its use was very much confined to medicinal purposes until within the past twenty years. As to maize, William Cobbett probably first propounded the idea that it might be successfully grown in this country, and one of his sons spent many years in endeavouring so to acclimatise a variety of this plant that the ripening of its corn might be a *fait accompli* in the generality of English autumns. Experience proved his anticipations to be too sanguine, but the plant is likely to become worthy of extensive adoption for a far different purpose—to

provide heavy crops of green forage for cattle and sheep at the latter part of August and throughout September and October.

Mr. H. M. Jenkins has so comprehensively treated on the cultivation of sainfoin and lucerne in France and other parts of the Continent in papers which have recently appeared, that although they are among the most valuable of our green-crops not commonly cultivated, the space at my command will be best utilised by confining the present inquiry to the claims of cabbages, thousand-headed kale, sprouting broccoli, kohl-rabi, green maize, gorse, and prickly comfrey. Lucerne and sainfoin pre-eminently deserve to receive greater attention from British farmers, and to have a more widespread adoption; and several other plants might be added to the list, but the present paper must be confined to the products about which the farming community stands in greatest need of information.

Carrots and parsnips may both be regarded as crops not commonly cultivated, the superiority of which for many stock-feeding purposes has been proved over and over again. But so much has first and last been written about the former, that it would be only repetition to point out how excellent carrots have been found to be for horses and milch cows in the winter. The fact is tolerably well known also that the large white Belgian and other kindred varieties will often yield on stonebrash and gravelly soils, not very kindly for swedes, quite as heavy produce as of the last-mentioned crop. As for parsnips, they are well known to be far richer in nutritive properties than any other roots grown for the feeding of stock, but the labour and expense of digging a crop out of the land after being grown are so great, that the adoption of parsnips into legitimate British farming can never be expected to increase very much.

The lupin is a plant with which English farmers are less acquainted than either of the preceding, although it is grown extensively on the Continent, and considered specially well adapted for poor arid soils. In vol. xxi., First Series, of the 'Journal,' published in 1860, there is a well-written article on this plant by Dr. Voelcker, followed by an account of Mr. J. W. Kimber's experience in cultivating it in Oxfordshire. Dr. Voelcker's conclusions were, that "green lupins are a useful crop, which must be grown in England with much advantage on poor sandy soils on which clover, sainfoin, and other kinds of produce do not succeed well;" and that yellow lupins are also "useful as a green-crop for sheep and cattle." Mr. Kimber, in the wet summer of 1860, endeavoured to save his lupin-crop for seed, and when he found the season so unfavourable, fed it off. He said, "I think the crop is likely to prove valuable on light sandy soils, where there is a difficulty of getting large crops of the ordinary farm plants.

Of the great quantity of green food which it produces I can speak with certainty, and I can express a favourable opinion of its feeding value."

Sorghum saccharatum was considered by many people eligible for adoption as a green-crop into English field culture some years since; and in dry, hot summers, a very fair produce was grown by those who made trial of it. But the many failures which adverse seasons brought, at length disappointed even those who at the first believed they had in the plant a grand treasure, and little has been heard of it in this country for some time.

Amongst other plants which deserve to be mentioned are the Jerusalem artichoke and the golden melon. The former is grown extensively for stock in foreign countries, and as it is generally found perfectly at home in all soils and situations, and one of the hardiest as well as the most productive of vegetables on poor land, advocates of its claims for more favourable consideration have always more or less appeared. But when once the Jerusalem artichoke has been allowed admission to any place it resolutely refuses to quit it ever after; consequently the plant is seldom allowed into any land subject to regular rotation, and is usually banished to shady out-of-the-way spots and odd corners of fields, from which fresh plants spring up every spring, although they are clean dug for tubers every autumn. The golden melon has been imported here from the United States, and presents an ornamental appearance when the vines spread themselves over the surface of the ground like vegetable marrows or cucumbers, and golden fruit of the size of large turnips appear. The plant can be made to grow very well on all dry fertile soils, but a much less weight of produce than mangolds or swede turnips would generally be realised.

Cabbages.

Cabbages have been adopted into English field culture on a small scale for so long a period that the only reason for including them in the category of crops not commonly grown rests on the limited extent to which they still find favour with the rank and file of the farming community, despite the fact of their high utility having been continually pointed out ever since the commencement of the present century, and probably long before. The following extract from Arthur Young's "Farmers' Calendar," published in 1805, may be given in proof of the latter statement.

"I must urge our young farmer to determine to have as many cabbages as he can want for cattle, sheep, and swine from the 1st of October to the last of

December. The use is so great, so exceedingly valuable for autumnal fatting of oxen, feeding cows, fatting wethers, feeding hogget lambs, and supporting the whole herd of swine, that one may without hazard assert the farmer who does not make a provision of them to be negligent in a very material point of his business."

Nothing can be more true than this statement, which is fully verified by a considerable amount of sound practical experience at the present day. For instance, Derbyshire and Staffordshire dairy-farmers find that, when grass falls short in autumn, nothing tends to sustain the milk-yielding capabilities of their cows more than to be able to supply them with a few cabbages daily. They are grown specially to meet this object on some farms in the Midlands, and occasionally not only afford a valuable provision all through the last three months of the year, but have been found to stand perfectly sound in the fields up to the end of February. What sheep-breeders and sheep-grazers would do without the cabbage seems inexplicable; especially those who are in the habit of preparing prime specimens of their flocks for exhibition would be at a loss how to proceed without the aid of this valuable plant, and its near relations kohl and kale. The Eastern Counties cattle-grazers, without autumn cabbage, would be unable to keep their fattening beasts when on short pastures in a satisfactory state of progression. Pigs are as fond of cabbages as of mangold-wurzel, and where large herds of swine are kept, there cannot be a more economical system of management than to be able to feed them partly on cabbages in autumn. Professor Buckman, who for many years has grown autumn cabbages rather extensively on his farm in Dorset, considers that although the weight of crop he can realize is not much over twenty-five tons per acre, which is not quite equal to that of a good yield of swede turnips, it is of more value to him during October, November, and December than any other kind of green produce. In some instances much weightier bulks of produce are realized by the Drumhead variety being grown. For instance, Messrs. Sutton and Sons' "Imperial Early Drumhead," which often yields cabbages weighing 30 lbs. each, has the reputation of producing from 50 to 60 tons per acre. No one need marvel then at the glowing accounts which now and then have been given by farmers at their club meetings, to the effect that, although cartloads were daily taken away to the fattening beasts, the dairy cows, and the pigs, the yields continued to be of the "cut and come again" character, while the flock in clearing up the remainder in the field enjoyed fixture of tenure throughout autumn at least.

Autumn cabbages are available for consumption when other green food is scarce, which is a chief reason for their being

accounted so valuable. On sheep farms early turnips can no doubt be grown for the flock, but unless these are over-abundant it is always an advantage to be able to commence with cabbages ere trenching on this reserve; and for dairy cows and grazing-cattle there is nothing else, unless some of the other crops not commonly grown are cultivated. Another cause may be found in the highly nutritive value of the cabbage, which ranks far above that of most other vegetables, thereby rendering much less artificial food necessary to keep stock thriving. Added to this, when it is borne in mind how partial so many kinds of stock are to this produce, and that it does not affect them injuriously even while taken in large quantities, as many other things do, a case will be made out for cabbage being grown on an extensive scale, which seems difficult to resist.

But the plant may be cultivated at different periods of the year, and summer cabbages are frequently found to be even more valuable than autumn ones. Young cabbages planted out in October and November will yield crops available for consumption in June, July, and August. In fact, on the Cirencester College Farm, Mr. Russell Swanwick has often had them come ready for utilisation early in May, and last season he made about 30*l.* an acre of a portion of his crop for marketing. If care be taken not to cut off the whole of the greens with the cabbages, the stalks will shoot out smaller heads, which are calculated to afford a great deal of valuable keep for sheep later in the summer. Those who market their early spring cabbages should remember this, very convincing testimony to the fact having been given by Mr. Russell Swanwick, Mr. Robert Russell, and others.

Nor must the fact be ignored that, in the hands of our leading seedsmen, certain varieties of the cabbage have been brought to such grand perfection that they come to maturity much quicker than the old sorts. Messrs. Webb and Sons, of Wordsley, claim for their "New Early Drumhead" that it can be brought ready for consumption in September from seed sown at the beginning of March and planted out in May. Messrs. Sutton and Sons state that their "Early Oxheart," if sown the last week in March, might be relied on for coming ready to feed the last week in August; and still more wonderful to relate, they assert that an entirely new variety which they have brought to a high standard of perfection by selection, came last summer ready for feeding the second week in July, although the seed for the crop was not sown until the 19th of March.

Two mistaken ideas operate in preventing thousands from taking up with cabbage growing, the one being that the soil must be deep and good for a satisfactory crop to be expected,

and the other, that the expenditure required is beyond the limit of ordinary farming. One very successful prize-taker for mangold-wurzel and swedes, as well as for sheep, writes to me thus:—

> "My arable land is mostly on the chalk, and therefore I have not succeeded in growing any crops but turnips, mangold-wurzel, and cole, in which produce I believe few men can beat me. I can only grow cabbage on the stiff clay, of which I have but little, and am consequently quite decided to keep to turnips and wurzel."

If the premiss in the last sentence had been quite correct, it does not follow that the conclusion arrived at is rational; for if cabbages could not be grown on the chalk, a few acres of them are so invaluable on a farm, that probably no and causing could be pursued than to keep this small quantity of clay land perpetually under cabbage culture. It happens, however, that some of the best field crops of that vegetable grown in England are raised on chalk soils. The time is not so long since when a very common impression prevailed that only the deepest and richest lands would bear mangold-wurzel. At any rate, a soil capable of growing roots of the latter good enough to take the highest prizes at an exhibition is sure to be of the character well adapted to grow cabbages.

When an erroneous impression of this nature is entertained by a large sheep-breeder, who has highly distinguished himself in other branches of agriculture, no surprise need be felt at the prejudices on the subject prevailing among the bulk of farmers, and causing even plots of cabbages in many districts to be few and far between. There can be no question that thousands of acres ought to be raised instead of scores, and that such would be the case if there were sounder practical knowledge on the subject. The very circumstance that the cabbage is found in well nigh every cottager's garden throughout England ought surely to be held conclusive of the possibility of adopting it into ordinary farm husbandry far more generally than is done now. There may be many soils much too shallow for cabbage growing in their present state, but not a few of these might be deepened by the subsoil plough, the steam-cultivator, or some other agency. Even farms remarkably thin on the rock have usually one particular field near the homestead much deeper in staple than the other land. Under such circumstances, would it not be advisable to select a few acres of the deepest for perpetual cabbage growing, considering the invaluable objects the vegetable is calculated to serve?

There is a still greater error in the assumption that the cultivation required for this plant need of necessity be more costly than for mangold-wurzel. A Norfolk man in reply to an

inquiry of mine relating to this paper, writes that, although he has had little practical knowledge in the growth either of this vegetable, thousand-headed kale, or kohl-rabi, he considers that the culture of one or all is "very expensive, as they require high farming." By the latter term, liberal manuring is no doubt implied, and the inquiry may reasonably be made whether either of these crops require as much outlay in the purchase of fertilisers as mangold-wurzel? The latter by degrees has crept into very general cultivation, high though the cost in manuring for it must of necessity be; and why should cabbage culture be retarded from extension, because nitrogen in some considerable quantity must be rendered either in the shape of farmyard-manure or artificial fertilisers, such as guano, nitrate of soda, sulphate of ammonia, &c.

No doubt the assumption may be drawn that nitrogen in tolerably large quantity must be supplied to the soil by the cabbage-grower, unless it be naturally rich in that element. Dr. Voelcker, in addressing the Farmers' Club on a late occasion, is reported to have said:—"The members of the cabbage tribe were gross feeders, and would assimilate much more nitrogen than bulbous root-crops. They, therefore, required a great deal of farmyard-manure, and when they could not have it, they should receive an ammoniacal substitutic such as nitrate of soda. They could not rely on phosphatic manures for good results, and, if they wished to grow heavy crops of cabbages or kale on poor land, it was all-essential that they should be liberal and not lay out less than three pounds per acre in manure."

This advice of Dr. Voelcker is very good, but would he not have to counsel the mangold-grower in the self-same terms? and did he not intend to restrict the term "bulbous root-crops" to turnips and swedes? The sum he named for manurial outlay seems not at all extravagant; for many growers of wurzel are in the habit of expending 4*l.* per acre in manuring for that crop. The formulæ of M. Georges Ville, the celebrated French chemist, of the quantities and kinds of artificial manures which are requisite to be employed for different varieties of produce to obtain yields of them in maximum quantity, having attracted considerable attention, and being stated to be the results of several years' careful experiments, it may be stated that he recommends precisely the same application for cabbage as for beetroot.

The idea that a heavy dressing of farmyard-manure is absolutely essential for either kind of produce would, of course, be held only by the old-fashioned farmer who knows nothing of chemistry, yet there are many who seem to be deterred from

cabbage growing by entertaining the notion that the crop would be sure to make extensive demands either on their home-made manure heaps or their pockets. Under such circumstances it may be well to state that the formula by M. Georges Ville for beetroots, cabbages, and carrots alike amounts to 4*l.* 9*s.* 2*d.*, being for what he terms his normal manure No. 2; the ingredients of which with their prices are given as follows:—

	lbs.	£	s.	d.
Calcic superphosphate	352	0	15	4
Potassic nitrate	176	1	18	4
Sodic nitrate	264	1	13	7
Calcic sulphate	264	0	1	11
Total	1056	4	9	2

The following testimony to the value of cabbage as a field crop has been kindly furnished me specially for this paper by gentlemen who have had considerable experience on this subject.

Mr. George Street, of Maulden, Ampthill, says:—

"Cabbages I have grown for many years, and would on no account be without them. My practice is to prepare a seed-bed, and sow the seed, 'Enfield Market,' about the first and second weeks in August. Soon after harvest a piece of fallow is selected, forked over for digging out the couch, a good dressing of manure applied, ploughed a good depth, harrowed, marked out with rows or drills about 20 inches apart, and in October or the beginning of November the plants will be ready for setting out, for which I pay 8*s.* per acre, pulling the plants included. I usually grow 4 or 5 acres, say 5 per cent. of the fallow crop These produce an immense quantity of valuable food. A load a day drawn off and thrown about for the lambs will keep them right, and be found of great value at a critical time of the year. If preferred, the lambs can be folded on the cabbage at night, and have a run in the day time. If the former plan be adopted, the second crop or *sprouts* should be folded and eaten off with cake or corn. Cabbages may be given to all kinds of stock with advantage. I found them invaluable during the drought last summer, as (being too heavily stocked) my sheep and cattle would have been starved without their aid."

Mr. John Turner, of The Grange, Ulceby, Lincolnshire, says:—

"Cabbages are a most valuable crop, and where land is suitable ought to be more extensively cultivated. I grow two kinds, the Early Enfield for summer use, and the Scotch Drumhead for winter. My Enfield seed I sow in beds on the 5th of August. I draw the best plants out and plant them into the land intended to produce a crop at the latter part of September or in October. The rest remain in the beds, and are not planted out till spring. The preparation of the land for the autumn planting is, after perfect working and the spreading of a good supply of farmyard-manure, to plough the latter under on the level, and after harrowing and rolling the surface down, to make slight furrows with the ridge plough the distance the rows are required to be apart. The cabbages are then planted about 20 inches apart in the furrow. I find for standing the winter in the fields that they are much better in a

furrow than on a ridge, or even on the level. In a storm the snow preserves them so much better both from the weather and game. I ridge and manure the land in winter for planting in spring, which latter is effected as early as possible, and generally concluded about the middle of May. I commence consuming the autumn planted ones in June and go on up to Christmas. The Scotch Drumhead seed I sow as early as possible in the spring, and transplant them from the nursery beds to the land about the middle of June. I find we cannot get enough weight per acre if they are planted later. We use them principally for ewes in the lambing season. The great value of the cabbage crop, however, is for consumption in the months of June, July, and August, for the lambs after they are taken off the ewes and before turnips are ready. They are invaluable then, and I have known them save a flock. In our cold climate we cannot grow catch crops as they do in the south; and after our clover eddishes are eaten, if turnips are not ripe, it is very difficult to keep a flock of lambs right without cabbages. They are very valuable, too, all the summer for calves after the mangolds are finished. There is nothing you can grow the same weight per acre, and no crop on which flocks will do better. I have tried several kinds, but only grow the two mentioned. I dress my seed well with paraffin before sowing, to prevent small birds from devouring it."

Professor Buckman, who farms at Bradford Abbas, Dorset, adopts a method of cultivation which, according to Arthur Young, was first practised by Bakewell. He writes:—

"I grow cabbages on land prepared as for swedes and mangolds, drilling 4 lbs. of seed per acre where the crop is intended to be grown in rows 20 inches apart as early as the season will permit in the spring. The plants when up are thinned out just as swedes and mangolds are with a 1-foot hoe. If there were a market for the plants they might be drawn out and sold at so much per hundred. Manuring for the crop consists of the ordinary dressing of farmyard-manure employed for roots, which is laid on in autumn and ploughed into the land before Christmas, and 3 cwts. of Proctor's manure distributed broadcast just before the seed is drilled. One inconvenience will be felt in the growth of cabbages in so much of the crop getting to its best at once, after which the outer leaves begin to fall off, and it diminishes in bulk instead of increasing, and, besides, the ripened hearts sometimes burst up or decay. This I endeavour to obviate by sowing three kinds of seed, the Oxheart, the London Market and the Battersea. All kinds of stock readily take to cabbage, and do well upon it; and I therefore recommend a few acres to be grown on the plan proposed; not, however, mixing the sorts as I have done, but by growing the three varieties in separate plots, which will come for use successionally in August, September, and October."

Mr. John Treadwell, of Upper Winchendon, Aylesbury, writes:—

"I grow the Enfield Market cabbage by drilling in a patch of seed in the last days of July or very early in August, 1 lb. of seed generally yielding sufficient plants for an acre of land. At the end of harvest I manure heavily and plough at once. About the middle of October I harrow down the land and mark out the rows 16 inches apart with the drill. The cabbages are planted about the same distance apart in the rows, but not square. I give 1*s.* 3*d.* per thousand for pulling and planting, and find that it takes about 22,000 plants to serve for an acre. They turn into heart, and are usually fit for cutting to commence at the end of May. I pick out the best for first consumption, and proceed picking more out as fast as they ripen, and if not

cut too low the plants will quickly sprout again, so that a good second crop may be obtained to feed off on the land with sheep in September. For the flock of Oxfordshire rams which I breed for sale annually, I find cabbage excellent food, which they have in alternation with vetches and mangold-wurzel all through the summer. We use these summer cabbages, however, for cattle as well as for sheep. Wheat grows very kindly after this crop, and I grow it on land which comes into rotation before wheat as seeds will not hit well in the succeeding crop after the cabbages."

Mr. Wm. Trethewy, of Tregoose, Grampound Road, Cornwall, states that he has been in the habit of growing the Drumhead variety of cabbage for upwards of thirty years, adding :—

"I had the seed originally from Mr. Elliott, Landulph, in this county, and he had the sort for some years before. I have tried other kinds for winter feed, but without finding any nearly so useful. They require to be well manured, and will keep, except in very severe winters, until the end of March or early in April. They are exceedingly valuable either for milch cows, or ewes and lambs. The seed should be sown in August, and the planting out of the young cabbages at from 2½ to 3 feet apart may be effected the early part of the ensuing June. I have seen other varieties that grow larger, but they will not stand severe weather, and require to be consumed as soon as they are ripe."

Sir Thomas Acland says :—

"Experience has taught me the great value of a few acres of well-manured cabbage in the autumn, when the quality of the grass is falling off. Cabbages repay amply a liberal outlay of dung assisted by Peruvian guano. For the last ten years I have generally had 5 acres on my farm, and throughout autumn, after grass gets less rich, a couple of loads per day are spread on the pastures for the cattle. The sheep are folded to consume on the land the portion not taken away, and by adopting this course there is no soil exhaustion."

Several of Sir Thomas Acland's tenants are following his example in cabbage growing by seeing the good results which follow the growth of the crop on his home farm of Killerton.

Mr. W. Stevens, of Broadclyst, says :—

"Cabbages are generally liked with us, and found to be very useful for all kinds of cattle and sheep."

Mr. J. R. Evans, of Benham Grange, Newbury, affords convincing testimony how valuable a crop may become in a season of scarcity for turnips. He states :

"On land in good condition cabbage will no doubt grow more food per acre than any other green crop. In the year 1870—a very dry season indeed in our district—I was afraid I should not get any swedes or turnips, in consequence of the drought. I had two small fields, one 4 acres and the other 3 acres, sandy loam in good heart ; we had dunged the ground and worked it ready for roots. One of the Newbury market-gardeners offered to come over and plant the two fields with Battersea cabbages, the large sort, at 5s. per 1000, to include plants and planting, so I agreed to have it done. He put in about 7000 per acre, commencing on Whit Monday, 1870, in intensely hot dry weather. I got two or three water carts, and several women with buckets, and filled the

holes with water as the men planted the plants, so that they were mudded in. Although the weather continued dry, nearly all the plants took root, and we had two magnificent pieces of cabbage. My roots generally, were quite a failure; but thanks to the cabbage, I was able to spin out a little green food for my sheep and cattle, the whole winter. I let them stand on the ground, cutting and drawing where wanted every day, and made them last till the end of March, 1871.

Mr. Charles Kent, of Dewlish, Dorset, writes:—

"I have grown cabbages on a small scale for some years, my crop being from 4 to 6 acres. I find it useful for lambs in the summer, for pigs after harvest, and for dairy cows, being very excellent food for those kinds of stock, and especially so for lambs. But there are a few things against cabbage culture, the crop is expensive to grow, particularly when the winter has proved severe for the plants, or a very dry season is experienced for planting. It is also a great exhauster of the soil, and the succeeding corn crop is not often so good as after turnips, although the entire crop be fed-off on the land. I generally grow cabbages after swedes with farmyard-manure thickly laid on, and the land extra well done."

Mr. Frederick Street, of Somersham Park, St. Ives, Hunts, says:—

"I have grown cabbages for the last fifteen years, and think no flockmaster should be without them in the hot summer months, from the middle of June to the end of August, or even later. I do not care for them for winter food, when other produce, such as turnips, kohl-rabi, &c., comes in, as they are liable to injury by the early frosts. I find that one pound of seed will produce sufficient young plants for an acre of land. This should be sown into a prepared seed-bed the first or second week in August. Immediately after harvest a piece of wheat stubble should be ploughed, scarified, and forked over. From fifteen to twenty loads should be carted out, spread, and turned in in dry weather for the portion of the crop which is intended to be earliest, and for which transplanting should be effected early in November. In mild winters, such cabbages would come ready for consumption at a fortnight earlier than those planted the following February. Still, in the past few years I have preferred to manure during winter, and put in at the latter period, or as early as the weather will allow, because I find, what with damage by frost, birds, &c., the cabbages require much filling up when set in autumn. In transplanting, the rows are marked out with a drill, two feet apart, and the setting takes place about twenty inches from plant to plant. The price I pay for drawing the plants and setting them is 9*s*. per acre. I prefer the Enfield Market variety followed by the Imperial."

Lieut.-Col. Sir Paul Hunter, Bart., of Mortimer, Berks., writes:—

"For many years I have grown Drumhead cabbage on a small scale. The plants bought and planted in March, and the crop fed-off with sheep in September and October. The plants are set a yard apart each way, and the animals do admirably upon them. I find that the largest cabbages grow on well-manured ground. On this they apple out better than in most cases, do not split, and are not affected by frost. After heavy crops of mangold, which yielded 48 tons to the acre in 1880, and 39 tons per acre in 1881, I grew, without applying any more manure, 16 tons per acre of cabbage—this on heavy well-drained clay and loam. My object was to put the sheep on the heavy land before the autumn rainy period. It is a pleasant spectacle to see

three or four sheep eating away at the same cabbage. I have had some specimens reach the weight of over 50 lbs. each. I have grown very heavy crops of cabbage from seed sown in April, drilled as for turnips; the sort, Sutton's Intermediate Drumhead."

The subjoined fact may be added to the above testimony:—In a prize report of Mr. J. M'Laren, published in the "Transactions of the Highland and Agricultural Society of Scotland" for 1857, he stated that he obtained 42 tons 14 cwts. of cabbages (value 18*l.* 6*s.* 6*d.*), and 26 tons 12 cwts. of turnips (value 12*l.* 6*s.* 7½*d.*) per acre, and that the profit made in converting these crops into mutton was greater in the case of the cabbages by 1*l.* 15*s.* 11¾*d.*

Thousand-headed Kale.

This hardy and highly productive member of the cabbage tribe was no doubt, in the first instance, like sainfoin and lucerne, introduced to this country from France, where it has been a favourite with market-gardeners for many years. English tourists imbibed favourable impressions of the French "*Chou à mille têtes*" thirty years since or more, and the Rev. Canon Huxtable and others about that period recommended the plant for adoption into English field culture, as calculated to prove a superior, extremely nutritious, early feed for ewes and lambs in spring. That this opinion was well founded has been abundantly proved since; nor is its use confined to the spring, as, like the cabbage, thousand-headed kale possesses the merit of affording highly serviceable green food at very different periods of the year. Thus, if a field be prepared early in spring, for April deposition of the seed by a manure-drill, the surplus plants may be drawn out in the ensuing month by thousands and tens of thousands to be either sold or transferred to other well-prepared lands to form successional feeding crops, while those left behind after the necessary hoeings furnish valuable food for lambs in July, much earlier than a crop of rape could be matured for the purpose. This is one of the methods of culture which is pursued by Mr. Robert Russell, of Horton Court Lodge, Kent, who has done more than any other man to interest the agricultural public in the good qualities of a crop which had extremely limited adoption until he read his two celebrated papers before the Farmers' Club in 1876 and 1877.

Those who delight in witnessing intensive agriculture profitably applied should pay a visit to the Horton Court Farm, which has been held in the Russell family for upwards of two centuries. The soil's capabilities to yield a full maximum return is there fully tested, not only by liberal manuring and

a high condition of fertility being kept up, but by rapid croppings. No sooner has one kind of produce been fed-off or taken away than the steam cultivator prepares the land for something else, and the fresh seeding or planting is conducted with marvellous celerity. Green cropping is carried out to an extent scarcely deemed possible by nine-tenths of those who occupy even the lighter soils of the United Kingdom. Thus, at one period in autumn Mr. Russell had 264 acres of cabbages, thousand-headed kale, and sprouting broccoli, 30 acres of swedes, and 30 acres of mangold-wurzel. A very large breeding flock is kept, and the intense enjoyment Mr. Russell derives in shepherding lies at the very foundation of all this enterprise. Although the farm is only 600 acres in extent there are often nearly a thousand sheep on it at certain times of the year. The great care and attention bestowed on the in-lamb ewes will be made sufficiently apparent by the following statement. The number of ewes forming the breeding flock in the autumn of 1880 was 351, of which not a single one was lost in yeaning, nor for a period of six months from October till April. Fifteen threw their lambs prematurely and fifteen turned out barren, and the remaining 321 reared most successfully 412 lambs.

Such results not only prove that Mr. Russell's character as a good shepherd admits of being fully substantiated, but also that the food on which the flock subsists must be perfectly conducive to health. His ewes and lambs are largely fed on thousand-headed kale, of which he speaks in the following high terms:—

"This is the least known, but most desirable, of any green crop I have ever seen. It is a plant that produces more food per acre than any other; does not disagree with any stock, nor does it impoverish the land; with me it has never caused sheep or lambs to blow or scour. Eighteen perches per day with a little oat straw have kept 270 sheep for three months without the loss of one."

Mr. Russell stated at the Farmers' Club in 1877, that he considers an annual profit of 28*s.* per acre to be derived from his flock after debiting it with every expense, which is another fact affording conclusive testimony to the high utility of his system of feeding and management, depending so intimately on green crops not commonly cultivated. As not a few may find it difficult to understand how he could possibly find room for 264 acres of cabbages, kale, and broccoli, with 60 acres of mangolds and swedes, on a farm only 600 acres altogether, the following additional facts may not be deemed out of place.

In the month of April from 40 to 60 acres are drilled with the seed, chiefly of kale, but smaller portions with that of cabbage and sprouting broccoli, at the rate of from 4 lbs. to 5 lbs. per acre. Broccoli seed is also sown broadcast the follow-

ing month among peas, which also furnishes stock in summer for transplanting. Extensive breadths of trifolium and trefoil are fed-off by the flock in May, which are kept ploughed up close to the sheep, not only in this month but in June, and, after being reduced to a fine tilth, form ground for abundant transplantings of all the three varieties named. The land is marked out 27 inches either way, and the plants are drawn and put in at 10*s.* per acre at all the points where the lines intersect, so that being set at equal distances from one another all over the entire expanse, horse-hoeings can be conducted down the length of the lands, across them, or in any other direction desired. Trifolium is a great favourite with Mr. Russell, and he certainly makes much more out of that plant than the generality of farmers are accustomed to do. Two causes contribute to this. He sows a large proportion of his seed early in August into stubbles where winter barley has been harvested. A thick abundant plant is in consequence generally ensured, which is very much protected in winter by the produce of the shed grain from the preceding crop. Then, in feeding, Mr. Russell does not wait until the trifolium blooms ere commencing, preferring to utilise the feed when the stalks are all succulent. Too many farmers, to obtain larger quantities, wait until they get hard and sticky, after which sheep merely bite off the tops and reject the remainder. When those incapable of prying into the true nature of things find three-fourths of the produce left, they blame the crop, and this is how trifolium obtains an ill name.

Thousand-headed kale is in danger of suffering in reputation in a similar way, by allowing the crop to remain too long before being fed down, and there is the less occasion for this in the case of kale, as the plants will sprout again after being fed or cut almost close to the ground when not too old. At Mr. Russell's, early in August last year, I saw a cutting of thousand-headed being effected quite to the ground, and the plants had only been set out in June, but they were intended to sprout out again, probably for feed the ensuing spring. A large proportion of the breadths required by the ewes and lambs at that period of the year is, however, raised direct from seed sown in August, when 20 acres or more of the stubbles earliest rid of corn are ploughed, cultivated, and drilled with thousand-headed kale seed. This crop furnishes sheep-feed at the latter part of April, and sometimes up to the end of the first week in May.

Mr. Russell has another favourite plant in a superior variety of cow-grass—Messrs. Sutton and Sons' "Single-cut." He obtains three loads of hay per acre from this, but it comes later than broad-leaved clover, and is not often harvested until July. According to the Horton Court system, it is generally ploughed up after

this grand crop of hay has been taken; and should the harvest not be early the land can be utilised for the August-sown kale-seed to be put into it to produce the crop before referred to for April feed. The flock feeds chiefly on vetches in summer after finishing with trifolium, and in the latter summer and throughout autumn principally on cabbages. Two acres of land are drilled to Drumhead cabbage-seed in October. Transplantings from this ground are effected in spring to raise crops for autumn feedings.

When questioned at the Farmers' Club, Mr. Russell affirmed that his sheep were accustomed to devour nearly the whole of the stalks of thousand-headed kale, and that he found very little, if any, waste. As this experience does not appear to be thoroughly endorsed by others who have made trial of the plant, no doubt the circumstance is referable to the cause previously pointed out that the crops at Horton are not allowed to remain until old. The fact becomes worthy of prominent notice, as a well-known sheep-breeder, reputed for his good farming in another part of England, writes to me as follows:—

"Thousand-headed kale-crops I have grown, and believe them to be very good for sheep, especially for ewes and lambs in the spring, but I should like them to be grown on somebody else's land, as on light land with a good tilth the roots will spread from row to row; in fact, they cover the ground like a young ash plantation. I once grew 2 or 3 acres, with swedes on the one side, and kohl-rabi on the other. They grew as high as the hurdles, and there looked to be an immense amount of food, but I believe the sheep got over them quite as fast as when on swedes or kohl-rabi, and I have no hesitation in saying that I carted off more stalks and roots from 2 acres, than from 20 acres of kohl-rabi."

Of those who have made trial of the crop, a great many more praise than speak ill of it; thus Mr. John Treadwell says:—

"I grow only a small patch or two of thousand-headed kale, just to have a little green stuff for my rams during winter and early spring. Last year I sowed some seed after the last summer vetches—in August, I believe. This turned out some very nice feed late in the spring, when consumed with a few mangolds, and the sheep did very well upon it. I think well of it, although doubting whether it will yield generally as much feed as a crop of roots."

Mr. Charles Kent says that thousand-headed kale has been grown on the large sheep-farms of Dorset for some time to a larger extent than cabbage, and is considered a very useful healthy green-crop for sheep and lambs. He adds:—

"It produces a large amount of feed, will keep well in frost, and in wet weather stock will thrive on it better than on turnips. Like cabbage, it requires the land to be well prepared, but I do not consider that it injures the following corn-crop so much as the former crop does."

Mr. G. Galpin, another Dorset sheep-farmer, says:—

"I am rather in favour of thousand-headed kale on light soils, as, although

I admit we do not get as much food per acre as from cabbages, yet, taking into consideration the respective expenses of cultivation and the time occupied in the growth, kale ought to have the preference."

Mr. Clare Sewell Read thinks that a late crop has more chance of withstanding a hard winter than a forward one, and he has rendered me the following particulars of his experience in making trial of the crop:—

"I have grown thousand-headed kale for half a dozen years, but last winter so entirely killed a fine crop that I am rather dubious about sowing any more of it for spring feeding. When intended to stand through the winter it evidently should not be too forward, or it may perish from the severity of the weather.* I grow it as I should swedes or mangolds, drilling it on the flat, 24 inches apart, and generally applying farmyard-manure, depositing from 3 to 5 cwts. of superphosphate with the seed. I have grown it upon strong land, sowing it in April, and feeding it off in August; on loamy soils drilling it in May, eating it between Michaelmas and Christmas; and have also sown some after vetches in June and early in July for spring feed for ewes and lambs. In all cases I have had fair, and occasionally very heavy, crops, and have invariably grown good cereals after the kale. But the stalks are a great nuisance, and a heavy expense to remove, and it must be consumed where it is grown to make the most of it. It is no doubt useful sheep-feed upon all lands that are at all unkind for turnips."

While a few crops like Mr. Read's were destroyed by the severe weather of the winter of 1880–1, the generality escaped scot free; and as some of the latter were decidedly more forward than his, an opinion of Mr. Russell will be well worthy of consideration, in the endeavour to discover the cause. Mr. Russell thinks that in Arctic winters kale on the hills has a better chance of escaping injury than that in the vales. His farm is situated tolerably high, and during the entire period he has been growing the plant he has never lost a single crop.

In April 1881 I expressed an opinion in 'The Field' that thousand-headed kale is far superior to root-crops in the capability of resisting frosts, and threw out a suggestion that growers of the plant would do well to make public their experience on the point how their crops endured the severity of the preceding winter. The ensuing week brought three replies, extracts from all of which will be of great interest.

Mr. A. J. Burrows, of Pluckley, Kent, wrote:—

"The extreme hardiness of this very useful forage plant has been sufficiently tested during the past season to enable growers to pronounce with

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* The 18th of January, 1881, is regarded as the most disastrous day to East Anglican Agriculture that has been experienced for upwards of 50 years. A level coating of snow, which had previously preserved all crops from the exceptionally severe frosts, was suddenly blown clean off the land into the roads and fences. The icy blast lasted for nearly twenty-four hours, and not only was my kale killed, but almost every other plant that was exposed to the awful hurricane was greatly injured or utterly destroyed.—Clare Sewell Read.

some degree of certainty as to its capabilities of standing the severest winter. Here we drilled in six acres of it late in May 1880, intending to feed it off in October; but an abundant crop of early turnips prevented this being done, consequently the kale stood through the winter, and has been finished within the past week. Late in autumn it was a marvellous crop. The severe frost of January caused it to droop considerably, as it was grown in an exposed field where no snowdrifts could protect it. And as the green heads were visible from a great distance, thousands of wood-pigeons were most assiduous in their attentions to the kale, at a time when turnip-tops, tares, and clovers were buried beneath the snow, and at one time they threatened its complete destruction. But no sooner did milder weather set in than the kale shot out afresh, and we at once commenced feeding part of it off upon the land, and carting the remainder to cattle in the yards, and ewes and lambs upon sheltered pastures. So vigorous were the thousand-heads at the end of March that a friend, well acquainted with the London market, strongly recommended their being gathered, bagged and trucked for Covent Garden. This would have been tried, as he prophesied that 'a fortune might be made,' had not other work absorbed all available hands at the time. But hundreds upon hundreds of loads were cut off and carted to the stock, and during the early weeks of the present month many a well-to-do neighbour and many a cottager enjoyed the luxury of 'a mess of greens,' gathered, by permission, when all the garden produce was cut off. The abundance of keep which the plot of ground has turned off since the end of February has been a cause of wonder to many, and I have had numerous applications for seed for the present year, so that I have been enabled to give Messrs. Sutton and Sons a good order, as the previous lot came from Reading. I should mention that this field of kale was grown upon the home farm of Sir Edward C. Dering, Bart., of Suwenden, and on heavy land. During the present week we hope to drill in several acres of kale for autumn feeding, and later on in the season—towards the end of July or the beginning of August—some acres more for the spring of 1882."

A Dorset agriculturist wrote as follows:—

"Last year I drilled in May some nine acres with kale. The snow certainly broke the plants down in a few places, but they withstood the frost in a wonderful manner. The difficulty that I found was in thawing the leaves sufficiently to make them suitable food for some sixty stall-fed dairy cows. Of course, too, during the heavy snow the crop became useless to me, as it was necessary to dig out each plant, and then it was a difficult matter to cut the frozen stalks. It is for these reasons that I think roots are preferable as winter food for stall-fed beasts. I find that some stalks of the plants cut early in the autumn have not sprouted out again as those that were cut in mid-winter. This, I suppose, is owing to the exposure throughout the whole winter without the natural protection from the leaves. My sheep are now folded over the stalks, and although, owing to the backward spring, there is not so much keep as there would have been otherwise, yet it is a very valuable piece of feed at this season of the year (April). As regards the cultivation of this crop I am a decided advocate of seed-beds, and for the following reasons:—(1) One-tenth of the seed used in drilling is sufficient. (2) Instead of 50*s.* per acre for artificial manures, one-fifth of the money is ample. (3) The fly (*Aphis*), so destructive to these young plants, may be more easily guarded against in a seed-bed. (4) More time can be spared for preparing the land, and the first crop of weeds can usually be destroyed. No doubt dibbling is more expensive than drilling, but I think that with cabbage-plants it is much cheaper on the whole. I have seen in this neighbourhood several very good pieces of kale, none of them at all damaged. Our soil is chalky and hilly, so that although exposed to the winds, perhaps our crops are less affected by frosts than those of a moister climate."

The letter of a third writer contained the following:—

"Last year I planted out late in June about 1½ acre of kale, and on the side of it about the same breadth of cabbage. The kale was not in the least injured by the frost and severe winter. The cabbages were all more or less destroyed. The snow which fell did not protect either crop from the frost, and the only advantage that the kale could have was that it was planted on a rather higher slope of the hill, and the cabbage may have been affected by the damp of the snow which was left on it. Sheep and lambs were fed on the kale till the middle of April, when the tops were picked and sent to market, to clear the ground for barley. I am informed by one who farms in N.W. Iowa that this kale is the only green-crop that will stand their severe winters. I may add one remarkable fact: that I planted out some kale in the earlier part of last year, and part of a flock of sheep were turned on to it in September, and that the sheep so turned on have had more lambs than the rest of the flock."

Mr. T. R. Hulbert, of North Cerney, Cirencester, appears not to have quite made up his mind whether or not the ordinary crops can be improved upon for such land as he occupies. He writes to me to the following effect:—

"I have grown a great deal of thousand-headed kale. It will some seasons grow a large bulky crop, but prefers black, peaty soils; is a slow-grower to start with. Sheep will eat rape much more readily; but it has this advantage, that it will remain much longer in the spring without going to seed. I do not consider it will grow the same weight of crop per acre, or yield feed so nutritious as cabbage."

Professor Buckman, on the contrary, says:—

"Thousand-headed kale was always a favourite of mine, which I have grown after the same method as cabbages, drilling the seed in the spring into the land where it is intended to be grown. This year I have a double crop of swedes and thousand-headed kale, plants of the latter having been set between every fourth and fifth swede in the rows. They make a capital crop together, which will now (November) be very soon ready for feeding. The swedes are not at all injured by the overhanging of the kale, but on the contrary, the protection afforded thereby has enhanced the development of the former."

Mr. J. R. Evans, of Benham Grange, Newbury, also observes:—

"In 1880 I cropped 5 acres at one end of my swede-field to thousand-headed kale. I obtained seed from Messrs. Sutton and Sons, and drilled 5 lbs. per acre as they recommend, in rows 2 feet apart, the time of sowing being about the middle of June. The plants were afterwards singled out, 14 inches distant from one another in the rows. The crop grew capitally, and the severe frost in the winter did not hurt it a bit, although our swedes all rotted. In April 1881, I had a first-rate piece of food for ewes and lambs, and I never knew lambs do better than mine while feeding it off. In the summer of 1881 I cropped three acres in a similar way, with the exception of sowing only 3 lbs. of seed per acre. This quantity I found to be ample, and have at the present period (February 1882) a very good piece of kale indeed; a much better crop than the swedes in the same field. In fact, I wish that I had sown the entire piece of land to the former. I shall not require to commence feeding the kale until April, by which time, if the mild weather continues, the greens will be as high as the hurdles. Some of my neighbours who have seen it like

the appearance very much, and say they shall certainly try some. The seed was rather too dear, 2*s.* 6*d.* per lb., but I think it is cheaper this year; drilling and cutting out, the same as swedes, is, I think, a better plan than sowing in a bed and transplanting, it saves so much labour, which is a great desideratum these bad times."

Mr. Russell grows double crops of swedes and kale as well as Professor Buckman, and his testimony fully endorses the opinion that the friendly protection of the one stimulates the bulbing function of the other instead of retarding it. Mr. Russell's testimony is also totally opposed to that of Mr. Hulbert, both as to the quantity and quality of the green-food produced. In some few instances complaints have been made of sheep not taking kindly to thousand-headed kale, attributable, no doubt, as in the case of comfrey, to the crop having overstood before being consumed. When such is the case the leaves and stalks should, perhaps, be passed through the chaffcutter. The latter plan is adopted by the Rev. E. Highton, of the Bude Vicarage, Cornwall, in feeding his milch cows. In a letter to me, dated Dec. 26, 1881, he says:—

"I have grown thousand-headed kale on a small scale this year. I put in the seeds in a fine seed-bed about March, and transplanted them into ground from which I had just taken a good crop of potatoes. I dressed the land well, and the growth of the kale is now very luxuriant, and I am using it in a way which I find very profitable. The large outer leaves are picked off and passed through the chaffcutter, which, by the bye, is better for cutting up 'lears' than the pulper, though the barrel pulper makes very good work of the flat-pole (Drumhead) cabbage. One meal of my cows each day just now is this chaffed kale mixed up with bran and crushed oats, and another is the chaffed kale and chaffed hay and straw mixed up into a warm damp mess, with bran and boiled crushed oats or boiled linseed. I find the milk larger in quantity from this kale than from a greater weight of pulped swedes, and I have been surprised at the amount of vegetation the kale has supplied. One meal of my pigs each day is a small basketful of this chaffed kale with a pint of oats crushed. I find it is eaten up more clean in this way, and so a larger amount of stock may be kept than if it is thrown loose to the animals."

The above testimony is all the more important as it fully confirms the theory which has been occasionally advanced that this produce is calculated to become a valuable food for milch cows in the dead of winter, after the autumn cabbages are all consumed, and before mangolds have been stored long enough to become ripe for use without scouring the animals. The point is also worthy of note that kale may be made a food for pigs in winter.

Sprouting Broccoli and Winter Greens.

The number of farmers having brought these crops into field culture is only small, but Mr. Robert Russell has for many years past grown the former extensively, and even in comparison with

thousand-headed kale, is almost inclined to give it the preference. While fully admitting that kale will yield the heavier weight of crop, and beats the other in hardihood, the purple sprouting variety of broccoli which he adopts affords diet of which sheep are particularly fond, and a great deal of money may sometimes be made of it in early spring for marketing, after which the stalks shoot out again, and yield a considerable amount of food for the flock.

The behaviour of one particular crop which was drilled April 1880, deserves to be chronicled. When about a year old, in April 1881, the marketmen were allowed to pick what they liked for 20*l.* per acre. After they had finished, the stalks sprouted out so abundantly again that it was resolved to save this second growth for seed, which was at that time worth 9*s.* a pound. In August a very fine crop of seed was taken, which realised about 4 sacks per acre; but the under stalks commenced shooting out again, and scarcely a month after the seed-crop had been taken there was a capital aftergrowth ready for feeding, and quite equal in quantity of keep to the generality of second-growth rape-crops.

This variety of broccoli attains to the height of from 2 to 3 feet; and as it spreads abroad considerably, the plants require to be set at about 36 inches distant one from another. The sprouts are often of great value for culinary purposes in spring, and French cooks are accustomed to dress them in a variety of different ways, from which circumstance sprouting broccoli first acquired horticultural fame. There would probably be a good demand for the first sproutings on an extensive scale in most springs, if the plant were cultivated on the farm more generally, which is a point worthy of being borne in remembrance. The seed is usually very dear, for which reason the system of raising the plants in nursery-beds and setting them subsequently into the land intended to produce the crop, is less costly than drilling the seed direct into the latter, as turnip-seed is drilled. Mr. Russell drills seed into a small portion of the land which he intends to crop, and transplants its surplus stock into the remainder, or sows the seed between the rows of peas and beans, and subsequently takes surplus plants thence for setting out.

Mr. Shirley Hibberd, treating of broccoli in a work entitled 'Profitable Gardening,' which has run through ten editions, says: "The old sprouting kind is very hardy, of strong growth, and is a first-rate sort for the kitchen-garden to supply nice purple sprouts all the winter." He recommends cottagers and gardeners to make three sowings, from the middle of April to the middle of June, adding: "It should have plenty of

room—not less than 2 feet every way when finally planted out —on account of its branching form of growth."

Another new candidate for field culture is "Buckman's Hardy Winter Green," so called because Professor Buckman some years since derived it quite new from the wild cabbage which grows on the rocks at Llandudno, North Wales. The Professor considers it a remarkably hardy as well as productive plant, and mentions that in 1866–7 it stood the severe winter better than any other. He informs me also that a hardy broccoli was derived from the same source—the Llandudno wild cabbage. Messrs. Sutton and Sons, Reading, to whom I applied for information specially referring to the winter green, in consequence of Professor Buckman having stated that he had transferred its propagation to their hands, have written to me as follows:—

"The variety was placed in our hands by the Professor some years since, and is unquestionably a very valuable plant. It is hardier and more productive than the Cottager's Kale, but does not seed so well, hence has not yet come into extensive cultivation. The proper time to sow the seed is March, and a very useful crop will be produced in October and November. It will also stand through the winter well, for late spring gathering, for market, or for sheep-feed."

Kohl-Rabi.

This plant has been adopted into English field culture for more than a century—long before the swede turnip was introduced. This is sufficiently proved by what Arthur Young states in his 'Farmers' Calendar.' He terms it Reynolds' Cabbage Turnip, and says:—

"It is a remarkable circumstance that very great and successful exertions were made in the culture of this plant thirty years ago, but that it went out of general use without any sufficient reason, for its great merit was then well known. Long since that period the ruta baga, or Swedish turnip, was introduced, but in Norfolk the depredations of the fly upon this plant have been so great that it is also in danger of being given up."

This was written just at the commencement of the present century, and the same fate appears to have been experienced by the crop ever since, coming into use spasmodically, by fits and starts, when a cycle of dry summers has led to unfavourable circumstances for turnip-crops. The experience of the leading old-established seed-houses bears full testimony to this. Mr. Sutton, Sen., of the Reading firm, recollects several ebbs and flows in the demand for kohl-seed, and is of opinion that the culture of the plant was increasing very much about ten years ago, since when there have been better yields of the swede turnip, causing kohl culture gradually to decline once again. This is entirely confirmed by Mr. Frederick Street, of Somersham Park, St. Ives, who writes to me as follows:—

"For several years in succession swede turnips could not be successfully grown. The land was said to be turnip-sick, but it appears to have been the results of seasons more than any other cause, as crops of immense weight, free from finger-and-toe, have been grown during the past few years. Kohl-rabi crops are not grown now to the same extent they were in the hot seasons from 1868 to 1874. In some counties during this period they almost superseded swede turnips. The cultivation should be the same as for mangold-wurzel. Only 2 lbs. of seed per acre should be drilled 2 feet from row to row. The period of sowing may range from the second week in April to the middle of May; but if the crop is intended to stand the winter, to give early feed for ewes and lambs, June will be sufficiently early for the seeding, and it may be put in up to the longest day. I prefer transplanting for a portion of the crop, in the same way cabbages are put in. A crop of 20 tons per acre in a good season can be grown after tares. The price paid for transplanting is 9*s.* per acre, and one wet season I transplanted 20 acres. I do not know of any sort so good as that for which the seed is supplied by Mr. Saunders, of Clayhithe, near Cambridge. This sort grows both quality and quantity, has a small top, and does not exhaust the soil to the same extent the coarser varieties do."

Quite as heavy crops, it appears, were grown when the plant was first introduced as have been experienced since, for Arthur Young quotes a letter written by Mr. Reynolds, January 15th, 1774, which contains the following:—

"This is certain, large crops have been obtained during the last two years in several counties, their produce having risen from 25 to 35 tons per acre; and if my memory serves me right, there are two accounts from Nottingham and York as high as 44 tons. Kent and Sussex have obtained near 50 tons, but one gentleman in Surrey has outdone all I have heard of. This plantation, and that no small one, produced upwards of 56 tons per acre in 1770. I have this well attested, and that many of his single roots weighed 14 lbs. each."

This crop has during the past twenty years been very much employed as a substitute for rape, no less than for swedes, in Essex and many other parts of East Anglia, as well as in some of the southern and western counties. Although rape may be a safe plant to calculate upon in the Fen districts, on other soils it is extremely liable to contract mildew, especially in a dry season. After long protracted scorching weather this prevails to such an extent that the produce turns out a complete failure, owing to the mildewed leaves becoming shrivelled and dry. In the decade from 1864 to 1874 not a few sheep-farmers adopted kohl instead of rape, and expressed themselves highly satisfied with the results of so doing. A Dorset farmer told me a few years since that he found kohl-rabi the most salutary of all his green-crops for lambs at the latter part of August and during September, and that they throve on it better than on anything else.

Mr. J. H. Blundell, of Eastwood House, Keighley, says:—

"Some of the Suffolk farmers grow kohl-rabi extensively, the practice with them being to allow the crones, or broken-mouthed ewes, to run over the

crops and eat the tops, which they do, leaving the bulbs untouched. These are afterwards cut off and passed through the turnip-cutter for the fattening flock."

Mr. George Street, of Maulden, is very much attached to kohl-rabi, which he has grown extensively for several years. He says:—

"My land had got turnip-sick, but I now find that after a rest or change of crop swedes do well again, and I do not think kohl-rabi would grow so large as at first if grown every four years. My practice has been to select the cleanest field of about 20 acres, and fork out the couch directly after harvest; plough after the first good rain, and drill about 2 bushels of winter tares per acre.

"These are eaten off when quite young, as soon as the roots are finished, by ewes and lambs, the latter having a pen forward each day, with plenty of dry food and a few mangolds thrown about, which are cleaned up by the ewes that follow the lambs, lamb hurdles being placed between the ewes and the lambs, to enable the latter to run forward. As soon as 3 or 4 acres are eaten off, the land is manured, ploughed, harrowed and marked as for cabbage, and planted with kohl, at a cost for pulling and planting of 8*s.* per acre. The plants may be grown in a seed-bed; but as I have been in the habit (until this year) of growing about 60 acres a year, I generally have another field ready for setting out about the time the plants are required, from which they are pulled, before the crop is singled, like swedes. If no plants were to be had, I should drill kohl-rabi seed where the tares could be eaten off early enough, and the rest of the land would go to green turnips; but of course where plants are at hand ready for planting there is a considerable saving of time. A dry hot summer is most suitable for kohl-rabi. The best crop I ever grew was in 1868, when the root-crop was so generally a failure. About the same weight may be grown as of swedes, taking one year with another, but more sheep may be kept, and more mutton made per acre. My men prefer kohl to any other roots for sheep, cattle, or horses. I grow the medium sort, carefully selecting for seed those with a moderate top, sufficient to stand a frost, with a well-formed bulb and small stalk and root. I have but little trouble with the roots, which can be picked up when the barley has been sown, at 6*d.* per acre. This may seem incredible to some, but if the ploughs are rightly set and the land is ploughed the same way as it is drilled, nearly all will be covered in. It should be distinctly understood that my remarks apply to light land, as I do not consider kohl-rabi suitable for heavy land, and I should add that I usually chop them off close to the ground with a hoe or picker, made like an adze, and they are then cut up for sheep with a Gardner's turnip-cutter, just as swedes are. If the sheep are allowed to eat them on the ground there will be more waste, and the cost of picking up the roots will be considerably increased. The great advantages of kohl-rabi are: that it is a good substitute for swedes when the land is tired of the latter; that kohl, compared with swedes, is of superior feeding quality; and that, if a portion of the fallow be clean enough, it may be manured, ploughed, and drilled early, so as to give plenty of time to clean the remaining portions of the fallow either for swedes or for transplanting the surplus kohl-rabi plants from the early-cropped portions into it.

"With the exception of cabbage, I do not know any way of producing so much food per acre as by first taking a crop of tares, eating them off very early, and then taking a crop of kohl-rabi. I have tried swedes, but they do not grow so well after tares as on a well-prepared tilth. Where good swedes can be grown, there is nothing better as a general crop, especially as they do not require sowing so early, and more time is allowed for cleaning the land; but

where land is tired of swedes, and is clean enough for early sowing or planting, kohl-rabi will be found very valuable. Kohl crops should not be allowed to stand too long in the spring, as, when the tops begin to run, the bulbs get dry and hard, and it is then highly desirable to give a few wurzels with them."

Green Maize.

An impression appears very generally to prevail that this crop will only succeed in producing a heavy bulk of autumn forage in hot fine summers. Professor Buckman evidently holds this view, as he writes to me as follows:—

"During some very hot summers, when at the Agricultural College, I grew maize to the height of 7 feet, but on repeating the experiment some plants only grew 6 inches high. Anyhow, as a crop-plant, I look upon it as one only likely to succeed in our finest seasons, and, in such as we have recently experienced, would be likely to result in utter failure."

Mr. Clare Sewell Read furnishes highly valuable testimony below, which shows that such a conclusion does not hold ground in respect to all soils. Mr. Read did not make trial of the crop until after his return from America, but, as will be seen, he has been fairly successful, although the seasons have been damp and cold. He says:—

"I have grown green maize the last two years with very fair success. Upon my return from America at Christmas, 1879, I brought home some early maize, and drilled it about 1 bushel an acre, 18 inches apart, in the middle of May. At that season there is no other grain sown, and the rooks were no end of a bother. Notwithstanding every effort to keep them off, between 8 P.M. and 5 A.M. they contrived to do a great deal of harm, and continued their depredations long after the young maize was up; indeed, they pulled up the seed when the plant was fully 2 or 3 inches high. This disaster past, the cold wet July of 1880 told against its rapid growth, but in August it ran up rapidly, some being 6 feet high. But the crop was much too thin, and although all stock eat it well when cut into chaff, it seemed to me too coarse. I therefore determined to sow it much thicker this year. I bought some common round and flat maize, and drilled it 9 inches apart, and 2½ bushels per acre, quite at the end of May. It was then a very dry season; the seed came up slowly, and I am sure fully quite 25 per cent. did not germinate, which is the usual allowance that should be made for all sorts of common maize imported into this country. Although the seed was dressed, the rooks were again most troublesome, and I shall next year smear the seed with gas-tar dissolved in boiling water. June was hot and dry, but maize evidently will always grow very slowly when young in this country, and should therefore be drilled wide enough to horse-hoe. During the harvest the wet weather seemed to suit it, and it grew vigorously. I commenced cutting it in September, and have not long finished it. The hurricane of October, and the frost quite early in this month, beat down and half-killed the maize; but the cart-horses eat it as well in its half-withered as in its green state. This year the maize was not so tall, but was much thicker on the ground, and certainly not so coarse in the stem. It weighed upon an average about 21½ tons per acre, and cows, horses, and pigs all seemed very fond of it. I could not see any difference in the growth or quantity of the fodder produced from round or flat maize.

"I am confident that maize should not be sown before the middle or end of May, as the slightest frost will cripple its growth, and a moderate amount of cold at night will kill it when young. A friable loam seems best adapted for maize, and it no doubt requires a heavy dressing of farmyard-manure. It is not fit to use before the middle of August, and it lasts through a season of the year when fodder crops are often scarce, and at the best most unreliable. I am so well pleased with the result of my two years' trial that I shall certainly repeat it next summer, growing it after vetches cut green in the spring."

I have been fortunate in obtaining a second good descriptive account of what may be done with the plant in England as a green-crop. It will be seen by the following that Mr. D. Sturdy, of Trigon, Wareham, Dorset, sows as late as July; but, presumably, as he feeds-off the crop on the land with sheep, the stalks would neither get so stout nor grow so high as by earlier seeding. No doubt sheep would feed them all the closer to ground for this, but the defection in bulk of produce which would naturally result has to be taken into consideration, and there is a remedy when the stalks are too coarse and hard to be readily devoured, that of cutting them up by means of the chaff-cutter. Mr. Sturdy says:—

"For nearly twenty years I have grown maize here, first in the garden as a vegetable, where it ripens perfectly, and also as a green-crop for sheep, and to cut for cows. It is only suitable for light or sandy soils. I began by sowing it 1 foot apart in the drills, but it grows slowly at first, and requires much hoeing, or the weeds soon choke it; so latterly I have drilled 3 bushels an acre, at 6 inches between the drills, and then it comes up thick enough to kill the weeds. I have sown it as early as May, but the best time with me to sow it for a green-crop is the last week in June or first in July. I have sown it in the middle of July, but that is rather late, and it is fit to fold about the middle of September. I have not, as a rule, applied any artificial manure. It seems to exhaust the ground, even where it is all fed off with sheep; the succeeding corn-crop is generally poor. Green maize is exceedingly healthy stuff for lambs; they never scour on it. Rooks are very fond of spoiling the crop after being seeded, and great trouble is occasioned to keep them off for nearly a month after the seed has been sown. Even if the seed be tarred, they will pull up the young plants when first making their appearance. I have grown both round and flat sorts, but prefer the European round. It ought to be tested before sowing, as much of the maize sold is either so old or has been so heated that it will not grow. The crop is very easily injured by frost, and ought to be all eaten off by early in October."

Mr. Sturdy's statement that maize is "only suitable for light or sandy soils," is probably only intended to imply that it has not been found to answer on the heavier lands, of the character generally found in Dorset. It will be seen from Mr. Sewell Read's statement, given above, that he considers "a friable loam" best adapted for maize, after having received "a heavy dressing of farmyard-manure." In the United States, as well as in Italy and elsewhere on the Continent, heavy loams, if dry in character, are sure to yield abundant produce of maize; and who

does not know that the American prairies when cultivated are rendered golden by the enormous quantities of maize they ripen as a corn-crop.

The Americans appear to have another way of keeping down the growth of weeds than the one adopted by Mr. Sturdy, of placing the rows near together. Professor Heath, of Columbia College, President of the American Institute Farmers' Club, in writing on Ensilage recently, gave an interesting account of the green-crops which could best be grown in the United States to meet the object in view, and said:—

"Maize is doubtless the most profitable and the largest yielding crop. It should be planted in double drills, 4 inches apart, and the double drills 28 inches apart, so as to permit cultivation with plough or cultivator. It is desirable to have the drills run north and south, so that the sun and air may supply the crop with the largest amount of nutriment, and the sweet varieties are best. Corn should be cut at early flowering. It is an excellent practice after cultivating between the double drills, to strew coarse manures between these drills. By this means grass and weeds are kept down, and the ammonia from the rains is appropriated by the crops."

A correspondent of the 'Times' last summer gave his opinion that English farmers might not only grow green maize for feed and forage more generally than they do at present, but that they might utilise a portion of what they grow serviceably by converting it to hay. As his letter explained several important points in American practice, I quote the following portion of it here. He says:—

"Although Indian corn or maize will not ripen in this country, it will grow sufficiently vigorously during the months of June, July and August to afford heavy crops of first-rate forage, known in the States as 'cow-corn.' In the Northern and Eastern States of America horses and cattle eagerly eat the leaves and tops from the stalks of Indian corn, upon which the grain has been allowed to ripen; the stalks themselves are too hard and dry for the stock. In the Southern States the stalks are not cut, but the leaves are stripped off when the ears are pulled, tied in small bundles, and, under the name of 'fodder,' are practically the only forage used for every description of stock. Horses, mules, and oxen eat it much more readily than the Northern baled 'Timothy hay,' which is sometimes shipped South. Indian corn, however, when cut green, is far better for stock than the leaves from maize raised for grain, and is, moreover, all eatable. 'Cow-corn' is usually sown tolerably thick, in drills 2 feet apart. It grows nearly as high as that sown for grain, but the stalks are only about as thick as a man's little finger, full of juice, and as sweet as sugar-cane. Cut young, and cured in small stacks, or 'shocks,' it dries green, and makes first-rate forage for stock of every description, particularly for milch cows. Horses and mules, too, eat it with avidity. From my own experience here I know it can be grown easily in this country, and if sown in June would be ready for cutting in eight or ten weeks, leaving ample time for any succeeding winter crop. Good land should yield 10 to 12 tons per acre of dried fodder. All the cultivation necessary is to go twice between the rows with a small one-horse cultivator, after which time the stalks are high enough to overshadow and keep down the weeds. The crop is cut by hand with an L-shaped sickle called a 'corn-cutter.'"

Another purpose for which green maize has been recommended, is to supply dairy herds with an accession of green forage at a period when the autumn pastures begin to fail. Feeding cows with green maize has been lately under consideration in France. M. Genay gives his experience in this matter. With proper manuring he got as much as 155,000 kilogrammes of maize per hectare (62 tons per acre). He says the cows don't take to this fodder very well. They have to be gradually habituated to it, by mixing the maize at first with bran and oilcake. But in a few days they will eat enormous quantities of maize alone so long as it is green and tender. They are previously fed about three months with clover alone. "Now, whenever the maize *régime* is fairly started one notices three things: the quantity of milk diminishes; likewise the proportion of the cream to the milk; and less butter is obtained from the milk. The butter, too, becomes white, like that of winter. These effects are more pronounced as time goes on. They may be counteracted with a little bran and oilcake." M. Genay finds it still advantageous to sow a certain quantity of maize, because in years with a very dry summer, this fodder may prove a valuable aid in the maintaining of the cows.

Prickly Comfrey (*Symphytum asperrimum*).

Never surely were there so many conflicting opinions as to the value of any crop for agricultural purposes as of this. Mr. H. Doubleday, of Coggeshall, Essex, has written of it, that "four or five cuts of 20 tons each to the acre may be taken when the plants are fully established, and they will last for twenty years if the ground is kept clean and occasionally stirred." But against this the following statement of Mr. T. R. Hulbert, of North Cerney, may be set in opposition: "I believe prickly comfrey to be quite a delusion. It wants very good land, plenty of dung and attention, and no stock will eat it if they can get plenty of other food." This is pretty nearly confirmed by the subjoined testimony of Mr. Sewell Read, who, it will be seen, urges other objections against the plant.

Mr. Read says:—

"I have a small plot of 'Prickly Comfrey,' planted four years ago. It did nothing the first year, but after a good manuring in the second season it was cut three times, and yielded a large produce. Last year it only produced two crops, and this season only one came to mow, and I ran the sheep over the second growth, which I did not consider worth cutting. No stock appear fond of it, the leaves are tiresome to collect, and the plants difficult to keep clean, and costly in the first instance. My comfrey is planted upon a calcareous clay, and I certainly shall not extend its culture, for I am confident that lucerne will produce twice the weight per acre of a more nutritious, and certainly more palatable fodder."

The aversion of stock to the leaves of the plant may, it appears, be got over by passing them through the chaff-cutter, and then mixing the pulp up with something else. By taking this course, the produce may, in times of great scarcity for other cattle food, be found of peculiar value, as the Rev. F. Gilbert White, of Lensdon Vicarage, Ashburton, experienced it to be last spring, the subjoined statement from whom was made public on April 30th, 1881:—

"This spring, in spite of my having neglected to give the plants good mulching of stable litter to protect them from the frost, they again came up early and strong, and gave promise of a most abundant yield; but the old difficulty of not knowing what to do with it again recurred. The end of the mangolds, which we were pulping to mix with our chaff, loomed close at hand; the coming in of vetches or any other green food looked a long way off in the cold, dry, easterly winds. Then a new idea struck us. We brought two large hand-cart loads of the luxuriant young comfrey leaves up into the hay-loft. We laid them in the trough of the chaff-cutter, with about equal quantities of hay and of forage (*i.e.*, of oats cut before the corn is ripe enough to be threshed out), and we cut up all together; then we left the large heap to welter for two or three days upon the floor. The result is that we now have an abundant supply of sweet moist food, which every cow, calf, and horse eats with the utmost greediness, literally licking out their mangers lest a fragment of the leaf should escape them; and this, with the aid of a little decorticated cotton-cake, will render us independent of all extraneous aid till summer is fully come. I may observe that the cook, who knew nothing about the cows' change of food, at once remarked upon the improvement of the butter, both in colour and in texture."

Professor Buckman has recently informed me that prickly comfrey was always a favourite plant of his, and remains so still, as he obtained three pickings from his roots last season. As a soiling plant, however, he expresses a great preference for lucerne, from which, in the same time, he obtained as many as four good cuttings. The Professor here touches on a point which is well worthy of attention. The two crops named by him can never come into competition, for, wherever lucerne thrives, there cannot be the slightest doubt of its being by far the most valuable. Still there are numerous places for which this invaluable forage-plant would be ill-adapted, and where prickly comfrey would do well.

Sir Thomas Acland sends me the following:—

"I have found that prickly comfrey is a very valuable addition to our food at all times of the year. Once established it requires no trouble. It may be planted in any odd corners of the farm; under trees, or on the sides of old ditches and wet places where hardly anything else will grow. Comfrey is propagated by sets off from the root, which is easily divided. I am told, on the authority of a noted stag hunter, that comfrey is an excellent food for horses."

The bull's-eye is fairly hit in the above statement; for nothing can be more true than that the special value of comfrey consists

in being so well suited to plant odd spots, which, if not thus occupied, would only produce weeds. One serious objection to planting comfrey into good land in the open field appears to be that, once there, it is most difficult to eradicate again, being equally tenacious of life, and as fond of retaining dominion over land once held as the Jerusalem artichoke.

Mr. W. Stevens, of Broadclyst (Sir Thomas Acland's chief local manager), has furnished me with the following particulars on the growth of comfrey at the home farm, Killerton :—

"We have grown a small quantity of comfrey during the last four years. I am inclined to think it will be found a useful crop, although not so well liked by cattle as cabbage. We get three cuttings a year, and the crop produced is a heavy one. The cattle like it best just as it begins to come into flower. Growers will find it important to attend to this, as, if allowed to stand too long, the stems get hard and tough, and much is wasted."

Probably the true reason of the repugnance of stock to comfrey, in some instances at least, may be that it is not gathered at the right time. At all events there is very conflicting evidence as to the likings and dislikings of the same kind of animals for the produce of the plant. In the following interesting statement, which a Cornish clergyman has been good enough to send me, it will be seen that comfrey food is adverted to as being relished well by the stock to which it was given.

The Rev. E. Highton, of Bude, Cornwall, writes :—

"I am very pleased to give you my experience of comfrey growing, although I must state that it is quite on a small scale. I only keep a couple of cows and a few breeding sows, and the whole extent of my comfrey is not a quarter of an acre. The land where it grows is to a great extent shaded by large trees, and I could not previously get anything to thrive there satisfactorily. On this account I consider my growth is below what it would be under more favourable circumstances. Four years since, in November, I obtained about 200 roots from Messrs. Sutton and Sons, Reading. After digging holes about eighteen inches deep, and the same in diameter, I filled them with good half-rotted manure, covering it up with the soil taken out. Into each of these hillocks, of which there were fifty to the square rod—about 2½ feet apart each way—I put a single set, which was covered with about two inches of soil over the top. In May, the following year, I got a fair cutting, and three more during the season. Every year since I have cut four times, and sometimes five. The first two cuttings are heaviest. After each cutting, well-rotted manure is put round the root. With reference to the weight, I find this note in my diary of April 24th, 1880:—'Cut a head of comfrey weighing 6¼ lbs., an average-sized head, fifty to the square rod.' A few days after this, each head weighed considerably more; but I believe that as great a weight of fodder is obtained in the course of the year when cut before it runs to flowering stalk, and the animals eat it much better. At a low computation, I should think an average of 4 lbs. a head for each of four cuttings, is got here, which would give 16 lbs. a head for the year, or nearly 60 tons per acre. My comfrey is partly on damp ground, occasionally overflowed with water, and partly in very dry, rather strong ground. The piece

in the damp ground is the more luxuriant, although the other grows very well, but the leaves are apt to become dryer on a continuance of dry weather. With regard to the consumption, I find that horses, cows, and pigs, are equally fond of it. The crop furnished green food from May to November for my horse, which only required a very little chaffed hay and straw besides, with half the corn usually allowed, *i.e.*, three quarts instead of six quarts a day. The cows eat it after being cut like other green food, but next season I intend to put it through the chaff-cutter mixed with hay and straw, and then add crushed oats and bran, as I think this will be a more economical mode of utilisation. The pigs have hitherto had the comfrey thrown to them on the manure-heap, and they pick out the stalks and devour them after being trodden in. In future, I hope to put it through the chaff-cutter for them as well, and give it with crushed oats. I may mention that the roots I originally procured from Messrs. Sutton have been sufficient to plant out all my ground. At the end of the first year, I took up and divided several roots, from one of which I obtained between forty and fifty sets."

Mr. Highton's success in growing a heavy produce is plainly attributable to high manuring with good fat farmyard-dung in preparing his land for the sets, and the point cannot be too strongly enforced that, unless the soil be naturally rich in deep black mould, the extraordinary produce the roots are generally expected to yield can only be realized by a similar course being adopted, or by correspondingly large applications of artificial manures being made.

How far certain facts, the result of experiments made by Professor Buckman several years since, ought to modify this opinion readers may judge for themselves. He says:—

"Having procured a few sets with roots attached, we planted them in a plot on the cold clay of the Forest Marble, previously slightly manured. These sets grew rapidly, and we were soon enabled to divide them, until we had as much as a quarter of an acre of ground occupied. The crop was enormous, and this too upon land of very medium quality; but we have since then been trying its growth on light sandy soil, and can report that, all through a season of drought, the thick deep roots of the comfrey have drawn up the moisture which rises hygrometrically in our sand bed, and the result has been a succession of green leaves when surface plants were an utter failure."

The plant is very much liked by Lord Moreton's farm-manager, Mr. Jno. Watts, of Whitfield Farm, Gloucestershire, who writes to me as follows:—

"Five or six years ago, when prickly comfrey sets were 10*l*. per 1000, Lord Moreton bought some, and had them planted out in ground trenched for the purpose. This was done about 18 inches deep and well-manured. The sets were planted just below the surface and about a yard apart. There have been immense crops cut during the season, often yielding 15 lbs. per plant, and if the season be favourable, five crops a year can be produced.

"One of the *chief* advantages derived from this valuable forage plant is, that it is so much more forward in spring than any other green food, and therefore greedily relished by any kind of stock.

"The practice here is to cut it up with straw into chaff, which, 'when

roots become scarce and straw dry and husky,' enables us to keep the store stock in the yards a week or two longer, to give the grass a good start.

"At other periods, through the summer, it is used for 'weaning calves,' pigs, horses, or any other kind of stock that may happen to be about the 'homestead.'

"There is no doubt that persons in business, who keep a cow or two, or a horse, would find the prickly comfrey a most useful article of fodder, and like every other kind of agricultural commodity, the better it is treated the more satisfactory will be the result.

"The cultivation of it is of a very simple character, an ordinary hoeing once or twice in the season to keep down the weeds, and a coat of dung in the autumn, forked or dug in, are all that is necessary, so far as my experience goes."

Dr. Voelcker gave an analysis of prickly comfrey, vol. vii. Second Series of the 'Journal,' adding thereto the statement:—"In comparison with other similar food I may say that comfrey has about the same feeding-value as green mustard or mangold or turnip-tops, or Italian rye-grass grown on irrigated land."

Prickly comfrey is probably grown in Ireland to a far greater extent than in England. Popular opinion appears, however, to be as divided there as here respecting the advantages to be derived by growing the plant. Not long since, the subjoined letter appeared in an Irish newspaper:—

"I see several of your correspondents write you about planting prickly comfrey. My advice to them is, under no circumstances to allow it into their land, otherwise they will never be able to get rid of it. I got my farm about six years since, and in one of my fields there was a good deal of prickly comfrey. None of my beasts or sheep will eat it; and I have grubbed, and harrowed, and picked, subsoiled, harrowed, and grubbed, and still I cannot get quit of this horrid weed. I have employed men and women going over the field with iron prongs, 1½ feet long, raising it out by the roots, and, notwithstanding, I cannot eradicate it. I know a gentleman in the north of Ireland who planted it some years since; now he wants to get rid of it, but finds it impossible to do so. Can you, or any of your correspondents, tell me how to kill it?"

In reply to the above, Mr. E. Smyth, Knock's House, Clonakilty, wrote that he was acquainted with a great many stockowners who are delighted with prickly comfrey, and adding:

"I have been using it now for some time, and can certify that my horses and cattle are very fond of it. Some refused it at first, but all take it now greedily, and I am planting a lot more of it. I am now using the fifth cutting for the year."

The plant has attracted attention even in South Australia. A correspondent to the 'Darling Downs Gazette' says:

"I planted some roots of prickly comfrey in January last, four feet apart. They grew a dense mass of leaves, and ultimately covered the intervening space. Three weeks ago we had a hailstorm that riddled all the leaves. I cut them, and gave a quantity to an old cow that was used to hand-feeding—they were new to her. She left several times, but always came back again, and ultimately she ate the whole. I gave the rest of the leaves to a lot of

yearling heifers; they seemed to relish them, for they gobbled them up in a very short time. The plant requires clean, rich, well-manured land."

Gorse.

Gorse, known in some districts as whin and in others as furze (*Ulex Europæus*), has also claims of perhaps the highest kind to be considered a crop which, although not generally cultivated, has been found of great service. Mr. J. Forrester (Lord Portman's manager at Bryanston, Dorset) is accustomed, when the spring is backward, and other green food not plentiful, to have the young shoots of wild furze bushes gathered by the cart-load from the extensive sheep-downs belonging to the home farm and brought to the homestead to be crushed, cut, and mixed up with straw, chaff, and other food. Farmers on the borders of large heath commons and wastes, no less than those in the neighbourhood of cattle and sheep runs, are accustomed almost yearly to do the same thing, and in this nomad way gorse is the source of much valuable food. But the hardy wild plant, when transferred to field culture, often proves a perfect treasure, especially on poor soils, usually destitute of roots and green food of other kinds in the months of March, April, and May. Mr. Martin H. Sutton says of Gorse: "It produces such a large supply of food for such a small amount of expenditure, that it deserves the notice of every stockmaster." One of the good qualities of the crop is, that when once a plant has been obtained, like lucerne, sainfoin, and comfrey, it retains possession of the soil and goes on to yield fresh produce without renewal for several successive years. The best way to form a plantation is to work a piece of land to a fine tilth at the latter part of March, or in April, and deposit the seed in drills, 9 inches apart, at the rate of from 20 to 30 lbs. of seed per acre. Some cultivators are accustomed to put in only about half these quantities of seed, and to place their rows at about 18 inches apart.

Probably much more extensive breadths of land would be cropped with gorse in the present times of agricultural depression but for the fact that after the seed has been sown no returns come until the autumn or winter of the following year; or in other words, that it takes two years to mature the first crop. The young tender plants also require a little attention the first summer, so as not to become choked with weeds. One of the chief advantages of drilling is that it gives the opportunity of hoeing being effected during the first summer. After a good strong plant has been developed, there is no difficulty or expense whatever; from tolerably good land annual cuttings have been made, varying from 7 to 10 tons yearly, and such a quantity of produce may be confidently calculated on for many years.

Some farmers who grow it in rows, 18 inches apart, very much prefer to cut only alternate rows at any one time, by which arrangement all the furze, before being cut, has the advantage of two years' growth, and it appears that the shoots of two years' growth are not too hard for stock-feeding after having been crushed. Most growers prefer to take cuttings, in the winter or early spring, when it is difficult to find any other green food. The affluence of the furze plantation at this period is what, indeed, causes it to be of greatest value.

Horses are fond of crushed furze, and they thrive well on it, this kind of food being considered to impart to their coats a glossy and sleek appearance. Indeed, the discovery that the plant was available as a food substance for stock was first made during the Peninsular war. The cavalry horses of the British army having no forage on the mountain steppes of Spain, a bright idea struck somebody that perhaps they could be made to eat the furze shoots with which the country abounded; and the result of a trial with the pounded shoots saved a large number of horses from starvation. For dairy cows in the winter and early spring, crushed furze is of special value, as it not only causes them to give large yields of milk, but so improves the quality of the lacteal secretion as to occasion a larger proportion of cream and butter than from the consumption of any other green foods.

As to the nutritive qualities of gorse, Mr. J. Waller says:

> "It contains much more solid matter than either turnips, mangels, or carrots, which are the crops generally used as forage during the winter months, and, like most plants belonging to the order *Leguminosæ*, also contains a much larger amount of nitrogen or flesh-forming constituents."

The results of chemical analysis, whenever made, have always been to confirm the high opinions formed by practical men of this produce being extremely nutritive in character, and it does indeed seem strange that the plant is not more generally cultivated, at least on stony and shallow soils, worth little for other cropping. The plant also is capable of converting to high utility the sloping banks and odd waste places of farms in general.

Conclusion.

The fact should be borne in remembrance that among some crops generally grown there are uncommon varieties which are not as yet so highly appreciated as they deserve to be. Our leading seedsmen all have specialties in mangolds, which are richer fleshed, or better modelled, or less fangy than ordinary sorts, yet the bulk of the farming community ignore the fact,

and, for the sake of a trifling saving of from *2d.* to *3d.* per lb. in seed, cultivate what is likely enough to yield the worst instead of the best of its kind. There are also rare, common, and mongrel members of all the leading clover and grass families. Mention has already been made of the importance attached by Mr. Russell to having the true cow-grass, which comes to cut a fortnight after broad-leaved clover, and of which he obtains a crop of hay frequently weighing three tons an acre. Seeds are often palmed off on the farmer as being *Trifolium pratense perenne*, which do not belong to that tribe at all, but, on the contrary, to those of coarse and inferior red clovers. Messrs. Webb and Sons' Imperial Giant Cow-grass is a variety between red clover and cow-grass, which many farmers speak well of as growing high, and yielding two, and sometimes three, cuttings a year.

Trifolium incarnatum is cultivated very generally, still it is not made to render anything like the valuable service it might do, in consequence of the stalks being allowed to get hard and sticky before the produce is consumed. Farmers might avoid this evil to a very great extent by commencing to feed earlier. but there is another way which does not appear to be so well known. Messrs. Sutton and Sons have propagated and brought to great perfection two later varieties of this crimson clover than the one usually grown, one of which they term *Trifolium incarnatum tardum*, or late red trifolium, which possesses all the productive properties of the earlier kind, but comes to feed a fortnight later. The other is termed *Trifolium incarnatum tardissimum Suttoni*, or "Sutton's extra late," which must be a valuable kind, indeed, if all the allegations made in its behalf are correct. Messrs. Sutton and Sons say: "It comes in quite ten days after the ordinary *late* red or *late* white, and produces half as much food again as any other variety, and is very hardy."

Then again, in regard to vetches, there is the "Goa" kind, which is a stronger-growing variety than either winter or spring vetches. It has been most extensively adopted in Scotland and the North of England, and is often termed the "Scotch Gore" kind in other districts. Mr. Russell Swanwick prefers to sow it instead of spring vetches when the seed is easily procurable and not too dear.

Both Italian rye-grass and the common English rye-grass employed in alternate husbandry are liable to great adulteration, and the tons of rubbish and injurious weed seeds which are marketed and sown on farms one year after another may almost be considered a source of agricultural depression—one, too, of farmers' own seeking. Some truly frightful disclosures have been made from time to time where samples of ordinary rye-

grass seeds, such as are too often employed, by some chance come under scientific observation. The seeds of couch-grass so much resemble common rye-grass to the common eye, and are so often ripened with it when a crop is saved on a not very clean farm, that occupiers of land who buy of one another propagate the pest unknowingly, and yet on a wholesale scale. Most of the leading seed establishments have specialties in rare kinds, and Messrs. Sutton and Sons write of their Improved Italian that "it is very distinct in its character and seed from any other rye-grass, and as it is not strictly perennial in habit, it is more suitable for alternate husbandry and producing early feed in the spring for sheep and cattle than for use in permanent pastures. It is especially useful on account of its rapid growth."

Double crops, either of two kinds of green produce grown together, or a green crop between rows of beans or peas, are not at all general, although in the hands of skilled cultivators they have often been attended with a large measure of success. A novel and ingenious way of obtaining cheaply a large stock of kohl-rabi plants is that of mixing up a small proportion of the seed with the mangold-wurzel seed before it is deposited by the drill. The plants serve the double object for filling out the blank spots where the mangolds fail, kohl bearing transplanting so much better than young mangold plants, and for transference to other lands. The kohl plants left in the mangold field are never found to injure the main crop, as the mangolds overtop the kohls while together; the latter, however, after the former have been lifted, will continue to grow throughout the ensuing winter if allowed to stand, and not unfrequently mature a considerable quantity of keep.

Even when kohl-rabi is not habitually grown it is often found serviceable to raise young plants in a nursery-bed purposely to have stock to plant out into the fields of swedes, which are too thin of plants, or happen in certain spots to be bare. Mr. C. Kent, who grows from 120 to 140 acres of mangolds, swedes, and turnips, annually, always finds it advantageous to have a reserve of kohl plants to fill up the crops where necessary. He says:—"Kohl-rabi is useful as a filling-up plant when other crops, especially swedes, are thin."

Mr. Robert Russell invariably sows the seed either of thousand-headed kale, sprouting broccoli, or turnips between the rows of beans and peas after the last horse-hoeing, and many other farmers cultivate common turnips among beans and peas. Mr. J. Treadwell writes to me as follows:—

"I generally get a good deal of feed by a catch crop of turnips grown amongst the peas and winter beans. I drill in about 1 lb. of yellow Tankard turnip seed to the acre as soon as peas or beans are hoed the last time, and as

soon as the corn is cut, flat hoe between the rows of turnips, and then, if the harvest be early, single out the turnips as soon as the corn is carried. By this means I usually get a nice crop of stuff to eat in the early autumn, which makes a good preparation for wheat. Of course, this could not be done on very heavy land."

The fact has been well known in some districts for many years, that no more serviceable green crop for the summer feeding of weaned lambs can be grown than spring vetches and rape mixed together. By the subjoined communication from Mr. J. H. Blundell, of Eastwood House, Keighley, it will be seen that oats may advantageously be added to the mixed crop. He says:—

"I find the mixture of 1½ bushels of spring tares, 1 bushel of oats, drilled together, per acre, and 4 or 5 lbs. of cole seed (rape) sown with the barrow on well-prepared land produces a quick and most abundant crop of food. The first sowing may be made in April, and by the end of May or beginning of June will be ready for consumption. It should be eaten when the vetches are in bloom, and in favourable seasons will run up quickly to the height of two feet, or even higher. This mixed crop I have found to come ready earlier than kale."

There is still another system which was recommended by Mr. Coussmaker, of the neighbourhood of Guildford, for sheep-feeding on clay soils, in a discussion at the Farmers' Club some few years since. This gentleman stated that he was in the habit of earthing-up one-half of the mangold crop in heaps on the land where grown, the other moiety being carted to the homestead to be consumed by cattle. The lifting took place in October, and the ground was at once ploughed and sown to vetches. Sheep are not purchased until the ensuing summer, when the vetches are commencing to bloom and fit to consume. Then the two crops,—or rather, moieties of crops, it being convenient to cart half of the vetches to the homestead,—are fed together, the mangolds being placed through the cutter and given in troughs, and the sheep thrive so well on the mixed diet that they generally fatten rapidly without artificial food. Before they have half consumed the food in store for them, the vetches develop into pod,—the state in which carters are so fond of taking the crop for their horses, as they consider it to be "corn and green meat" combined. Probably a slight extension of the system would enable clay-land farmers to keep much larger flocks on their arable land in summer and autumn than they do at present. Larger breadths of mangolds might be cultivated to be treated in this way, only portions of the land might be sown to rye and winter-oats, the feed of which would mature sufficiently early for a flock either of hoggets or ewes and lambs to be brought in about the first or second week in April, just at the period when store sheep can be purchased most advantage-

ously in the generality of seasons. Both the rye and winter-oats would spring up afresh after being fed down, and no difficulty would present itself, with mangolds *ad libitum* to fall back upon, in keeping the flock supplied with food until the vetches were quite ready for breaching off.

The uncommon systems, no less than the uncommon crops, appear rather numerous; some are practical, according to one set of circumstances, and others are not, but all may have their respective adaptations to different soils, situations, climates, and conditions of farms. Meantime it cannot be wrong to learn everything possible about them from those who have gained experience on their merits or demerits, and what advantage or the reverse is likely to accrue from their cultivation; and I beg heartily to thank those gentlemen who have rendered me so much practical information, which has not only been of material assistance to me in the preparation of this paper, but will no doubt tend, if anything does, to render it acceptable to British stock-keepers.

Entirely wrong would it be to designate any kind of produce "a fancy crop," simply because it seems to require costly culture, if it can be clearly proved that the return it is calculated to bring fully corresponds in magnitude with the outlay incurred. The fact that when land is sustained habitually in a high state of fertility the various members of the cabbage family may be grown with far less expenditure in artificial manures, and generally yield much greater weights of produce than in other cases, has been fully demonstrated. There can be little doubt that cabbage, broccoli, kale, maize, and comfrey are all gross feeders on manure, and most of them require large quantities of that kind which is most costly to buy—nitrogen. This is why high farming and their culture naturally go hand in hand, and probably ought never to be severed. Still it does not follow that those who have not the necessary capital to adopt high farming in the management of the whole of their lands should have nothing to do with these crops. They might in all cases appropriate a single field or a few acres to the growth of these most serviceable crops—growing no corn whatever thereon, and sustaining permanently this small portion of their holdings in a state of high fertility almost corresponding to that of a market garden. In all probability mangold-wurzel would on the generality of farms also be grown with far more economy on a smaller acreage more highly farmed than the rest of the arable land from which corn would be totally excluded.

Whatever the price which growers of cabbages, kale, and broccoli may have to pay in manurial outlay, &c., their returns may often be so very much enhanced by a portion of the produce being

marketed that these crops have frequently proved the most remunerative of any on the farm. Mr. Charles Randell, of Chadbury, Evesham, in his evidence before the Royal Agricultural Commission, stated that the only way in which he had steered clear of a large annual loss, in the four years 1876 to 1879 inclusive, was by increasing the growth of other than ordinary crops. During the five previous years of 1871 to 1875, he said that his sales of seeds and vegetables only amounted to an average of 87*l.* 14*s.* 3*d.*, but during the four years ending with 1879, these returns had averaged so much as 551*l.* 2*s.* 2*d.* per year.

Mr. Randell's farm is 570 acres in extent, yet he told the Commissioners that it was by paying some attention, which he was now doing in an increased degree to other than ordinary farm crops, that he hoped to see the way to steer clear of losses in farming in future. What is still more to the point, he gave an example of his practical working of his theory by showing what an extraordinary good return he had realised from a 16-acre field in that special year of depression 1879. Early cabbages were first grown and marketed, and they realised 520*l.*, which was 32*l.* 10*s.* per acre. Then a second crop was raised, partly of cauliflowers and partly of cabbages and cabbage-plants, the sale of which caused the total returns for the year from this particular field of 16 acres to amount to 852*l.* 10*s.* The cost of producing these crops, including manure, labour, rent outgoings, and everything, amounted to 580*l.*, leaving a net profit of 272*l.* 3*s.*, or 17*l.* per acre. Moreover, it appears that the same field was in the following spring made to mature a crop of early peas, the pods of which were picked and sold in June for 16*l.* 5*s.* per acre, and Mr. Randell, at the period of giving his evidence, expected to net a second heavy return from the field for the year 1880. This illustration may perhaps be commended to the serious attention of those who so persistently declare that high farming cannot be made a remedy for agricultural depression.

The fact that prejudice, rather than a wise dispassionate judgment, often influences the farmer in the kinds of crops he elects to adopt, and the order of cropping employed, has frequently been admitted, and an unnatural bias or wrong impression too frequently also is allowed to operate in preventing the inquiry being as much as entertained, whether anything new or uncommon recommends itself to his attention. The Scripture maxim, "Prove all things, hold fast that which is good," ought more thoroughly to be reduced to practice in British husbandry, no less than in a great many other matters—not, perhaps, to the extent of making the farmer a perpetual and extensive experi-

mentalist; but a private trial-ground of a few perches could never prove a costly undertaking, and if devoted to a test for new plants and improved pedigree varieties of old ones, would be sure to prove a good investment by enriching the mind in knowledge, if in nothing else.

Nor must it be forgotten that an adverse opinion against the claims of plants not commonly cultivated has often been imbibed, owing to inferior or spurious varieties having been tried, an evil probably of more frequent occurrence than is generally supposed. There are several different sorts of thousand-headed kale, and the Jersey tree-cabbage is so much like some of them in everything but running up a stout stalk before developing branches and heads, that an unprincipled dealer in seeds might often palm off his old stock when the true kale seed is inquired for. There are also various kinds of comfrey, the solid-stem prickly member of the family being accounted the best, while as for the cabbages, their name is legion. Obviously, then, whenever any of the kinds of plants not commonly cultivated are about to be adopted, either for trial or regular cultivation, the wisdom of going to a leading seed-house for seeds, or to a propagator or nurseryman of well-established reputation for sets, seems fully apparent. Only by taking that course would the generality of farmers be able to make sure of obtaining the true varieties required.

V.—*Friendly Societies, State Action, and the Poor-law.* By the Rev. J. Y. STRATTON, Rector of Ditton, Kent.

AMONG the efforts which have been made of late years for the improvement of farm and other labourers of the wages-earning class in this country, none appear to have made less substantial progress than trustworthy Benefit Societies suited to their need. It is now nearly twelve years ago that, through the efforts of a small Committee,* a Commission of Inquiry into Friendly and Benefit Societies was obtained. By means of this Commission, of which Sir Stafford Northcote was the Chairman, a mass of evidence was taken, and a series of Reports,

* The Friendly Societies' Committee originally consisted of the late Earl of Romney, the Earl of Lichfield, the Hon. E. Stanhope, M.P., the Ven. Archdeacon Grant, J. Bonham Carter, Esq., M.P., W. Wells, Esq., M.P., L. S. Corrance, Esq., M.P., the late E. M. Richards, Esq., M.P., J. G. Talbot, Esq., M.P., the late Hon. and Rev. Samuel Best, Wyndham S. Portal, Esq., and the Rev. J. Y. Stratton. The Committee has been reconstituted, for the purpose of obtaining State action. Objects—(1) The bearing of the Poor-law on Friendly Societies; (2) Suggestions for legislation; and (3) Measures for carrying them into effect.

compiled with singular care and ability, published. Legislation followed in due course, and it is with the effect of such legislation, rather than with the evidence and reports which guided those who were entrusted with the inquiry relating to Friendly Societies, that I propose to deal. At the same time it is necessary to refer to the work of the Commissioners, and consider certain conclusions at which they arrived. They not unnaturally preferred, to untried plans and proposals, the development of societies, which, by their numerical strength or superior management, promised to secure to their members the advantages of trustworthy provident institutions. There can be no question but in this respect their recommendations have led to improvement, and, with due care in the administration of the law, they will lead to more. Persons who devoted their attention to the problem, how to raise the condition of the labouring classes by thrift, felt that time was needed in order to test in some degree recommendations which were entitled to respect, and which carried with them the authority of a Royal Commission. It was felt that the condition and progress, not only of the societies of the better class, which were managed by men of superior intelligence and skill, but of those mostly in favour with labourers whose lot does not remove them so far as one could desire from the influence and help of the poor-rate, should be carefully watched. If, by means of improved legislation, the experience of a few years gave a fair promise of a healthy growth of benefit societies, gradually overpowering the dividing or sharing-out clubs, and offering to labourers a sure refuge in their need and value for their money, then the inference would not fail to be drawn that an effective blow had been struck at the pauperising clubs in common use, to the advantage of the members. The savings of the poor, once absorbed and dissipated, in vain efforts to secure their provision, were at last likely to give them the benefits which savings rightly applied and protected would not fail to do. The reform was being attained, perhaps by a different road from that which seemed to those who had struggled for reform to be the best; but so long as improvement was going on, there was little or no cause for anxiety. But if we are met with portentous signs of failure where success was at least hoped for, if evidence is cropping up that the benefit societies of the rural poor are no better under the legislation of recent years, and it is doubtful whether they are not in some respects getting worse, the work yet remains to be done, and has a claim on the exertions of all who are willing and able to help. If the recommendations of the Commission failed to introduce remedial measures worthy of the name, we must resort to other means than those which they offered to us. Far be it from me to

depreciate the excellence of many of the recommendations of the Royal Commissioners. They accumulated an immense baggage of evidence, sufficient to furnish authors for all time to come with information of societies, sound or unsound, old and young, honest and otherwise. They related the career of societies of irreproachable character; they devoted attention to those which, like Thais of old, live by their lapses. It is impossible to question their diligence, or to raise any question on the valuable information embodied in their final Report, and especially, as it seems to me, of that portion which deals with the Poor-law in relation to Friendly Societies. The decision, however, of the Commissioners in deferring to a more convenient season the question of "State action" in, not the cost, but the management of insurances suited to labourers, is not only open to challenge, but, in consequence of the impotence of their recommendations in improving the condition of the rural poor by thrift, evidence is rapidly accumulating proof that further measures are required.

By the kindness and liberality of the Council of the Royal Agricultural Society, the writer of this article was enabled to fulfil a promise which he made to the Commission on the conclusion of his oral evidence, that he would submit for investigation and report his plan in some detail, relating to a system of sickness-pay and burial-money insurance, and other insurances, suited to the labouring classes, through the Post-Office. The proposal had already been much discussed, having been previously published in this * and other Journals, and brought specially to the attention of the Commissioners in a pamphlet,† the main object of which was to obtain inquiry into the legislation relating to Friendly Societies. Attention had also been given to it by the Commission for the Employment of Children in Agriculture. Its importance was recognised at Poor-law Conferences held in different parts of the country. A Memorial in behalf of the method was further drawn up by myself, and by the well-known authorities on Benefit and Friendly Societies, Mr. Wyndham S. Portal, the Vice-President of the Hampshire Friendly Society, and the Hon. Edward Stanhope, M.P., formerly an Assistant Commissioner on Employment of Children, &c., in Agriculture. This document (of which a copy will be found at the end of this article) sets forth the importance of a *self-supporting* system of insurance, mainly for sickness-pay and burial-money, and urged that the

* See 'Journal,' vol. viii. part 1, 1872, "Method of improving the Labouring Classes;" also *ibid.*, vol. vi. part 1, "Farm Labourers, their Friendly Societies and the Poor-law."

† 'Suggestions for Legislation relating to Friendly Societies.' Published by Ridgway, and reprinted in the evidence of the Commission for Children, &c., in Agriculture.

Act 27 and 28 Vict. c. 43 should be amended, to allow of the same being offered to industrious labourers by means of the Post-Office. It laid stress on the exaggeration of the difficulties alleged as to the protection and due administration of the sickness-pay; it also prayed that the useful, though but little-known insurance called "Endowments," might be offered to the public through the same channel. The Memorial was signed by the Archbishops of Canterbury and of York, by many Peers, Bishops, Members of Parliament, Justices of the Peace, Chairmen of Boards of Guardians, and others, to the number of upwards of 400, many of whom are well known on Poor-law and Friendly Societies' questions, and indeed on all subjects which relate to the welfare of the labouring classes. Copies of the 'Method' were duly sent to the Commissioners. It is doubtless matter of opinion whether my plan was entitled to special consideration. However this may be, a publication of the same and its principal details, undertaken for the purpose of investigation by them, supported also by such authority as I have mentioned, passed with little notice. The Method finds no place in the Appendix to the Report, and is nowhere referred to. No allusion is made to the refutation in it of the common and erroneous opinion that frauds on the sickness-fund are best prevented by espionage, or the surveillance of members of the benefit club over each other, although investigation would have proved that a system far superior had been in use in certain County Societies for half a century; my inference being that the system might, with the best results, be adapted, not merely to the area of a county, but to the whole country. They admitted that the main difficulty against a national system of insurance suited to labourers was the fear of imposition on the sickness-fund; and yet, with the means furnished them of disposing of the principal obstacle to which their attention was drawn by the memorialists, no inquiry was instituted into it. They came to the conclusion, "that without entering fully into this controversy, we are, upon other grounds, of opinion that it is not desirable that the State should, under present circumstances at all events, undertake what is called sick business." Mr. Stanhope's evidence is almost all the evidence taken in favour of the proposal; and although his evidence is entitled to great weight, there were points which required further investigation. Had this omission, which has caused some trouble to labourers * in the same field of work since the publication of their Report, been merely a matter entailing some disappointment to one who had devoted much time and

* The Rev. W. L. Blackley for one instance, whose earlier papers the 'Mark Lane Express' criticised somewhat severely for not being aware of what had already been attempted by others.

attention to the subject, it might have passed without notice. One hoped rather than expected that the outcome of the Commission would be the substantial improvement of the insurances of the labouring poor, but no one now seriously maintains that their recommendations have either attained, or are likely to attain, the result which all could wish to see. There is a concurrence of opinion, that further delay means continued mischief to the poor, and I am advised again to call public attention to my Method.

Meanwhile, as if to show how little good was expected from recent legislation, and how urgent the need of further effort to raise the poor out of their pitfalls, commonly called Benefit Clubs, and to place them on the *terra firma* of independence, an enterprise in every way remarkable, has for several years attracted a very considerable amount of sympathy and support. The proposal of the Rev. William Lewery Blackley for national compulsory insurance against destitution in sickness, infirmity and old age, and for the promotion of which the National Providence League has been formed,* has not yet, I believe, been published in detail. To discuss its merits would be foreign to the subject of this article, which is in favour of a voluntary system of insurance. Neither need I enter upon the inquiry on the probabilities that Mr. Blackley's plan would, if adopted, interfere prejudicially with mine, or with any sound Friendly Society, or system of societies already in existence. The opposition which his proposal has already met with in some quarters, from apprehension of injury, appears to have been founded in error. Let me pay a tribute to the admirable spirit and energy and great ability which Mr. Blackley has devoted to his arduous task, and pass on to efforts made by others to bring about a better state of things.

The attempts which have been made in Parliament to obtain further amendments of the law relating to Friendly Societies, furnish additional evidence of the opinion that steps must be taken to secure labourers against the risks they run, and the disasters which sooner or later befall them in their insurances. Mr. Harcourt,† M.P. for Oxfordshire, has given notice of his intention to bring in a Bill, the object of which is to make it penal for any person to establish or manage a society, the rules of which are not certified to be in conformity with the

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* See Appendix.

† Lord Lymington, M.P., is also devoting attention to the question, and has obtained an interesting return relating to the pauper inmates of unions who were formerly in benefit clubs. The return may be compared with that obtained by the Earl of Lichfield in 1868.

law, and the tables of contribution to be approved by an actuary. The remedy is, I fear, doubtful, unless subsequent supervision should be vigilantly maintained by the help of the actuary, and powers given to wind up the affairs of societies which failed to comply with the requirements of the Registrar, on the report of the actuary. There is, however, a suggestion of great practical value in Mr. Harcourt's proposal. To say that people may form or join any benefit club they like, is merely conceding the liberty of the citizen. It would not be easy to frame a law, which, while securing them against fraud or folly, did not interfere with their liberty to please themselves. But there could be no infringement of such liberty if, allowing people to form any clubs they liked, it were made penal for any manager or trustee of such club to hold moneys thereto belonging without giving security for the same, and duly accounting for the property entrusted to him, not merely on the motion of any aggrieved member, but as a part of the duties of his office, without discharging which, he should be dealt with as the law directs. An additional defence, and one of great value, might thus be secured to the insurances of the poor.

In addition, however, to the perils and dangers of private Bill legislation, which spring from the pressure of public business, all such praiseworthy efforts as Mr. Harcourt's must run the gauntlet of a powerful opposition. The fear that class interests are likely to be imperilled, leads but too frequently to a successful resistance.* The competition for insurances is very keen, and any attempt which might indirectly interfere with business and divert it from its customary channels is viewed with jealousy. The affiliated societies do not regard alteration of the law, or indeed any interference with their affairs, by the Registrar, with favour; and they unquestionably possess the power to make their opposition a matter to be carefully reckoned with in Parliament.

That the Unity and the Foresters will oppose any movement which is likely to benefit the labouring classes, especially of the lower degree among which they have not as yet made so great a progress as they desire, is improbable. The support which the affiliated societies gave to the Committee above mentioned, in obtaining the Commission of Inquiry into Friendly Societies, in the face of obstacles, and manœuvres ingeniously contrived by parties who did not relish the notion of investigation at all, must not be forgotten. It is doubtless easy to stir up the opposition of

* Mr. Gladstone was compelled to alter for the worse the Post-Office Act above alluded to, from the opposition here alluded to.

these large and important institutions even to salutary measures, but the old public spirit still survives among their leaders, and if need be will be forthcoming for the public good. I for one rely on the same open and fair treatment which was formerly expressed towards my proposal, when under public discussion, by Mr. Pinchbeck, then the Parliamentary agent of the Oddfellows and the Foresters.

Other influences against reform must, however, be taken into account in all attempts to alter and amend the law relating to Friendly Societies. Bankers are often connected with the Insurance Companies, and are unwilling to concede more liberty to the Friendly Society than they can help. Considerable difficulty, it is said, was occasioned by them to Mr. Fawcett, now the Postmaster-General, in his useful attempts to encourage thrift, by enabling small investments in Government Stocks to be made through the office. The opposition of the Insurance Companies and Bankers has made itself felt from time to time in hindering and restricting the business of life insurance through the Friendly Society. For instance, the highest sum which could be insured was formerly 200*l.* Subsequently an alteration was made, reducing it to 100*l.* It was again restored to 200*l.*, causing with each alteration the societies to alter their rules. It now stands at 200*l.*, on no very secure footing, if one may judge from the past, and the restriction imposed on the Post-Office, which is limited to 100*l.* as the maximum. The Act which enables insurances to be obtained through the Post-Office is, in more respects than one, an instance of dexterous opposition.

On the one hand, as I have stated, the limit is half that at present conceded to the Friendly Societies, by which means a considerable number of mechanics and persons of restricted means who desire to insure for upwards of 100*l.* will find their way to the Insurance Companies—very rarely to the Friendly Society. If enabled to insure for double the amount, they would, in many cases, doubtless avail themselves of the Post Office. On the other hand, the minimum amount of insurance, 20*l.*, is so high as to be beyond the reach of farm, &c., labourers, though a half promise was made to reduce it to 5*l.* by the late Duke of Montrose, formerly Postmaster-General.* Thus then, while the Post-Office was started on a most useful road for the good of the industrial and labouring classes, it was sorely crippled by these restrictions in offering insurances which are of a very profitable kind. It was, however, made very welcome

* The attempt was made in the House of Commons, but did not succeed.

to the business of annuities, the same being neither profitable nor popular.

Again, any measure which might affect the valuable property of the public-houses is not likely to pass without the keen scrutiny of the brewers. The late Mr. Tidd Pratt used to say that the "connection" of the benefit club was occasionally sold as part of the goodwill of the house. There is no reason to doubt the correctness of his statement. Here then are difficulties which, if one is to judge by the utterances of some who are most earnest in labouring for additional means to encourage thrift among labourers, have not received the consideration to which they are entitled. They must, however, be carefully dealt with by all who desire to join in the work of regenerating Friendly Societies, and to extend their usefulness.

Nevertheless, when we consider the character of those who take the lead in the mercantile and trading interests of this country, and how imperative is the duty of striving to better the condition of those who cannot help themselves, and who are worthy of the effort, an appeal for at least generous forbearance will hardly be made in vain. I do not rest our claim on their assistance, on the argument that the improved condition of the rural and other poor which enabled them to make a little independent provision, by means of moneys now mostly wasted in the vain attempt to obtain it, could lessen the number of members, or impair the influence of any sound society in the land; or could disturb the money-market to any appreciable degree; or, least of all, injure the interests of the brewer. The main argument to be submitted to their consideration is, that their help is sorely needed by their poorer fellow-countrymen, and that there is a responsibility which cannot be evaded or ignored by those who have made the commercial interests of their country the wonder of the world, not merely to abstain from obstruction, but to take their part in such efforts as are here earnestly, though with but poor ability, pleaded. Little real advance can be made in the arduous task of improving the social and moral condition of the poor, if it fails to elicit the sympathy and the support of those who have not yet done their part in the work, but have been led to view it as possibly injurious to their interests.

The position of the farm labourer compares not unfavourably with that described by me in this 'Journal' in 1872. Considering the depression in agriculture, which has impoverished landlords and tenants and ruined not a few, it is remarkable that the labourer has escaped. His turn may come, but not perhaps in a reduction of his wages or a rise in the price of the

necessaries of life. An illustration of the security of his position is afforded by his lot being in no respects the worse, and in some degree improved, during a decade, the greater part of which has been disastrous to English agriculture.

The class of labourers within range of the Poor-law is constantly receiving its accessions and sustaining its secessions, the effect of which is to keep it pretty much at a uniform level of intelligence and ability. Owing to the recklessness and profligacy of some who belong to a higher social grade, there is a gravitation downwards in the community which sooner or later settles in the lees of the peasantry, not much to the advantage of any one concerned. On the other hand, the labourers are constantly losing their best men, who make their way to positions in life according to their ability, and the "time and chance which happeneth to all men." Emigration, the proper outlet for surplus population, draws away from the old country a few of the best of them. One could wish that emigration would rid it of more of the indolent and dishonest, who, however, are chary about leaving their native land. Those who compose the bulk of the class are men who are fully entitled to a comfortable home and their own fireside as long as they live. That adversity may come, and the distress exceed the ability for self-extrication, gives them a claim for the help sufficient for their need from poor rate and charity, and assistance thus rendered cannot degrade the object of it. There are also many who, from infirmity of mind, or body, or illness, require the care of the Asylum or Union-hospital, and will need help from the rate, being persons who under no circumstances could insure for sickness-pay and burial-money. But, more than this, the labouring classes of this country, principally agricultural, are not, and probably never will be, able to dispense with assistance of a different kind to that which is drawn from charity or the rate. They want protection and care to enable them to secure that which of themselves they cannot obtain, and which "State action" should put in their way. And my plea on their part is, that they, having sufficient means to maintain the undisturbed occupation of their homes so long as the breath remains in their bodies, are, for want of such assistance, unable to secure their undoubted and just claims. I take the efforts which the labourer makes to secure his welfare by means of the principle which, next to religion, seems to be the most powerful and vigorous in this country, self-provision by mutual help, and record their failure. He joins a benefit club for relief in sickness, for provision in old age (sufficient to keep him out of the workhouse), and a sum to pay the funeral expenses, and the small outstanding accounts which he may owe in addition to the debt of

nature. He pays sufficient, and oftentimes more than sufficient, to secure this provision, and to what purpose? Is there one club* in a thousand which will fulfil the terms of his contract? The security is worthless, not from the dishonesty of the managers. Dishonesty is comparatively rare, though it crops up now and then. From sheer inability, either to administer the rules or take care of the capital, and from ignorance, which I believe is invincible, of the importance of holding on, even against the wish of the members themselves, to capital, the man's provision is lost.

The accumulation of two or three years' capital is considered to be so much surplus hoarded to no purpose. There are barely any societies among the poor in which deferred or prospective insurance is a matter of even a fair probability. It is almost a mockery to try and improve their societies by adoption of the admirable rules and directions issued by the Chief Registrar,† for the simple reason that once the excitement of the formation of their society is gone, and the guardian care of one or two painstaking men who get no thanks for what they do is withdrawn, there is nobody who can manage the business and take care of their property. I forbear quoting instances. They are probably within the knowledge of most of my readers who take an interest in village clubs. How far "duration" may be relied on in the affiliated societies is another question. It is possible to maintain a central authority in perpetuity, while some of the subordinate parts, the districts or courts, go to pieces. Perhaps for no better reason than that the local managers have failed to read and understand the rules which relate to general management, they find their district "out of touch" with the main body in the day of their struggle, and cannot claim the assistance they need to prevent disaster. Dissolution and re-formation, with loss of capital and some peril to "heavy" cases, may follow. Disasters of this kind do not arise from want of warning on the part of the authorities; but the local people are not fond of advice, especially if they have a few hundreds of capital, at a high rate of interest, in some local investment. Few, indeed, are the Friendly Societies of the labouring poor which can secure the payment of insurances deferred to anything like a period of twenty years. Is it wonderful that, amid such failure, prospective insurance is but little attempted, with the solitary exception of burial-money? Add to the inherent difficulties of management and security in

* The number of the Sharing-out Clubs is estimated to be greatly in excess of the certified Societies, but no return is given by the Commission.

† "The Form of Rules" on application to the Registry of Friendly Societies, Abingdon Street, S.W.

boná-fide societies, the dangers which many run by means of societies which maintain a staff of collectors who suffer the member to get behind with his payments till his insurance is forfeited, and all payments on it gone, and there can be no surprise at our being told that the sharing-out clubs are on the increase. The society which leaves prospective insurance to the poor-rates, and shares out all or nearly all the fund at the end of the year, is about as much as the man can rely upon for insurance, and rather more than he understands or can manage. With the help of the publican and two or three of his better-informed "mates," the leaky craft, to which he entrusts himself and his fortunes, sets sail, and he has a passage therein which, as the voyage progresses, costs him 80*l.* to 100*l.* or more, till he is thrown overboard to prevent shipwreck, and falls into the jaws of a system from which he never emerges with life.

And yet with these distresses, which it should be the care of the State to lessen as far as it is possible, if it cannot remove, the Commissioners could decide not to "enter into this controversy," and thereupon to pay no attention to the practicability of "State action" in the due management and supervision of those insurances which the labourer most of all needs—that of sickness-pay and burial-money. Their resolution has been for some years unfortunate for the labourer. How long is help to be denied him?

But I must be allowed to complete a description of the Friendly Societies among the farm and other labourers of this country, before devoting attention to the assistance which may fairly be rendered by the State.

The position of the member who, under more enlightened auspices, joins a society managed by the worthy squire or clergyman, is by no means commonly safe. The committee meet at the hall or the public-house, or the school-room, and for years everything goes on quietly and well. The society is duly registered; the Chief Registrar is not suffered to grow rusty in his duties for want of inquiries on points of law from the magistrate, and of morality and social importance from the vicar. The annual club sermon shall not lack, with its better teaching, something at least of the support of the highest authority on Friendly Societies. And so the cumbrous Blue-book finds a place on the pulpit-cushion, and portions of the last report are read out to the attentive congregation, and duly commented on in what the local paper will call an eloquent and practical discourse. Well, time passes on, and the vicar becomes, perhaps, a bishop, or is preferred to the world above, and the squire grows old, and leaves the management to others, who get everything into a muddle. What becomes of the society when it

ought, after years of care, in which it has done good work, to be the means of keeping the old members to the end of their days, and then providing the cost of interment? The young men of the parish dislike the old society; some few are joining the Foresters, but the majority have formed a splendid sharing-out club at the new public-house. The old men in the old Parish United Brothers find their capital of 700*l.* or 800*l.* going at the rate of 140*l.* a year, besides extras. The "botheration" returns to the Registrar are beyond the ability of any committee to understand, much less to fill up, now that squire and parson have gone. The country lawyer is of no more use than his clerk, to whom they went in the first place as *amicus curiæ*, and tells them wrong. At last the Quinquennial Returns roundly demanded by the Government Actuary drive the poor old fellows out of their wits. They make up their minds forthwith, "cut the Registrar and the whole concern," sell out the remaining capital, have a final jollification, not preceded by a service in the parish church; share out all the proceeds, as they say, *equally* (for do not all, irrespective of age, receive the same amount?), and by-and-by you will find a heavy percentage of our old friends in the Union.

The only remaining society which requires notice is that which, notwithstanding its admitted excellence and the good service rendered in promoting salutary alterations of the laws relating to Friendly Societies, is not so popular as it deserves to be. County Friendly Societies are sometimes called patronised societies, and the notion of patronage has become generally distasteful to the sturdy Briton. There are, however, other reasons why they have not as yet succeeded in attracting great numbers of the labourers. They work on the border-land of the dominion of the Poor-law. The provision which they offer to men who consider the funds of the rate their proper superannuation allowance, and if need be burial-money, which they have for nothing, is not greatly cared for. These societies are also regarded by many of our rear-rank labourers with suspicion, as a contrivance by which they may be made to forfeit their right to the poor relief. These feelings are turned to account by the keen emissaries of societies who make huge commissions, and if their representations prove ineffectual, the sharing-out club is ready to receive their recruit with open arms. It will be seen, then, that there are some little difficulties to be removed before he will enter the ranks of the safe and solvent benefit society. A short description of this most useful provident institution will not be out of place. It consists of a patron or patrons, a president, vice-presidents, trustees, a treasurer, auditors, and a secretary. A number of directors, consisting of magistrates, clergymen, trades-

men, &c., sufficient to carry on the management of the society in one or more towns of the county, is also provided. The duties of these officers and directors have an attraction for many who, like the late Mr. S. Estcourt, " warm up to their work." In addition to the management staff, " agents " of districts are appointed, who are paid by commission on their receipts, say 5 per cent. on all contributions and the first monthly contribution. The agent receives and accounts for each member's payments in his district, and on proof of illness or death, discharges all claims. He also pays the superannuation allowances. The election of members is the business of the directors, and the agent's duty is to send, together with the application of the candidate, medical or such evidence of health as may be sufficient for their decision. The usefulness of these societies would be greatly increased if the right sort of men were more commonly willing to undertake the duties of agency. It is not that respectable and trustworthy men are indifferent to the poor, but they fear that the demands on their time which the society would make, could not be easily met. The fact is, however, that after a little practice a fairly good agent will make from 10*l.* to 20*l.* a year, or more, with little or no interruption to the duties of his calling. Agencies, as experience proves, can be conveniently managed by district postmasters, who, provided they are properly paid for the work by commission, will soon make excellent sub-officers. They are, as a rule, thoroughly respectable and intelligent, and conversant with the management of small accounts. In the selection of agents it happens often that the plain straightforward tradesman who does the business of the society with fidelity and despatch, is but a poor hand at bringing in new members. It may chance that the man who could persuade them to join, is not quite the right person to be trusted with their money. Security is, however, commonly required. The society is fortunate which can secure a staff of agents who combine the happy knack of attracting industrious men and lads, with the business habits essential to the due care of its property. If one must choose, the latter qualification is to be preferred, though the recruits should in consequence come in but slowly. The County Friendly Society is valuable in rendering assistance in promoting good legislation. An excellent training in the law of Friendly Societies, and much useful collateral work in the Poor-law, and practical knowledge of the working classes, may also be gained by those who desire to turn their opportunities to account for the public good.

The means for the investment of the capital are as good as the law can make them. The securities are offered of the Savings-bank, the Funds, Exchequer Bonds and Bills, stocks,

funds, or securities guaranteed by Government, Bonds of the City of London, Bank of England Stock, East India Stock or Bonds, stock or securities of any colony or dependency of the United Kingdom, or on mortgage of freehold, copyhold, or leasehold property; on rates, tolls, duties, assessments, bonds, stocks, debentures, or other securities of any persons, body, corporation or company, municipal, sanitary, commercial, or otherwise, authorised by Act of Parliament. Here is a great variety for choice, and no income-tax to pay, or, if paid, repayment of the tax can be obtained on affidavit before the local Commissioner. There is no difficulty in obtaining good investment of Friendly Society capital at 4 to 4½ per cent. Provided that the contributions of members are kept in these dangerous days sufficiently high, and calculated at 3½ per cent., a source of income is available on the difference, which in some societies becomes very considerable.

Care should be taken to elect none but healthy candidates to be members. Something like 10 per cent. of those who pass with the agent, will be declined on the examination of the medical man and the deliberations of the board of directors. I refer, of course, to proposals for sickness-pay and burial-money. For old-age pay, no such precaution is necessary. "The worse the constitution of the candidate, the better for the funds." We are still very much in the dark about the duration of life of persons who are suddenly relieved from the labour and anxiety of obtaining a living. Their lives are wonderfully prolonged—to the ruin of the Annuity Society or the insolvency of the branch of the Friendly Society which is responsible for their insurances.

There is a danger in the air with respect to the contributions for benefits, that of their being fixed lower than they commonly are. The rough-and-ready rule of saying that a halfpenny a week shall secure a shilling a week in sickness and a tenth of the burial-money, does not err on the side of economy. It represents the calculation made by the members of the village clubs, and the rate at which they can afford, and are willing to pay, for benefits, their contributions being uniform, and not graduated according to age. Taking their own calculation, and stipulating for a fixed age—say 25—beyond which members shall not be admitted to the society, the contribution would, with good management, in time accumulate a *surplus* capital, and allow of a bonus,* of the greatest use to those members

* The County of Kent Friendly Society applies a portion of its surplus capital to this purpose, and also to the increase of old-age pay. A reduction of 25 per cent. on contributions for sickness and burial-money benefits after three years' membership is also given by way of bounty from the same source.

whose claims for sickness have expired by age, or other limitation.

The effort to establish and popularise Labourers' Unions, which was commenced a few years ago, has not met with the success which the promoters of the movement anticipated. There is no valid reason why the employers of farm labourers should view the Union with hostility. They can, if combination be improperly used, follow the example of their labourers or of the manufacturing classes,—combine and protect themselves. Where the Labourers' Union is led by men of exceptional ability, the results of a struggle with employers who do not organise are not likely to be altogether satisfactory. There were, however, unmistakable signs in one or two localities affected by agricultural strikes, that the English farmer would be roused by the action of the labourers to greater care and vigilance in the administration of Poor-relief. In this way the good of the community, and especially of the country labourers, who compose part of it, would possibly be promoted, though not exactly in the manner anticipated by their leaders.

One disadvantage the labourer does not commonly take into account when he joins the Union. If he refuses to leave his employment when the strike begins, he forfeits all moneys paid into the sickness and other benefit funds, and all claim to his benefits. He is turned adrift, possibly at an age when no club will enrol him on its list of members.

Some insight will, it is hoped, have been gained by a perusal of the foregoing remarks into the present condition and probable prospects of the insurances of farm labourers and others who belong to the wages-earning class. It will be seen that their societies are not improving, and that, unless other means are resorted to than those which the law in its amended form provides, there is grave reason to fear that they will go from bad to worse. The number of societies which register their rules and seek the help which is placed at their disposal is on the wane. That much opposition to the law, oftener indirect than open, is forthcoming, is no matter of surmise. Many societies will be maintained, not for the benefit of the members, but of their managers. Warnings or remonstrances in reports to Parliament by the Chief Registrar will be ingeniously twisted into the form of laudatory notices in local papers, or answered in so triumphant a manner, that the faith in the management, far from being shaken, is greatly increased. Doubtless much loss will continue to be inflicted on the credulous but honest people who fall into the hands of scheming adventurers in the Friendly Society. But the benefit and sharing-out clubs of the labouring poor are not fraudulent

institutions. They are not to be driven off the ground either by the affiliated orders or the County Societies. They give partial help at a cost which, properly applied, secured, and duly administered, would raise the condition of the labourer to independence. The imperfect help afforded by them is dearly purchased, even if the price was limited to the cash payments which the poor contrive to provide for them.

The question has again risen, What can be done to arrest the evils, and, if possible, to remove them? Nothing that is sound and solvent, or that with reasonable care can be so made, ought to be touched. Nor have societies which fulfil such conditions any reason to fear that the introduction of the Method, the main provisions of which I will subjoin, would be likely to affect them injuriously. The probability is that a national system of insurance would, by the increased attention thereby drawn to thrift, and the good model of a poor man's friendly society which it would supply, promote the usefulness of all well-managed institutions in existence. That it would tend to destroy, and succeed to some extent in breaking up, pauperising clubs, is a reasonable anticipation. If the suggestions which will be offered when I deal with the Poor-law should be adopted, we should have the indirect power of the guardians to discourage persons from forming societies which injure rather than benefit those who belong to them.

My plan is that a safe and easily understood system of insurance should be offered them at a cost not greater than they are already in the habit of paying for "benefits" in their own clubs, while their grip on the poor-rate shall be resolutely shaken off. That the system shall, for the present at all events, be managed by the Post-Office, inasmuch as the Act 27 & 28 Vict. c. 43, enables that department to undertake the management of insurances, for which it also possesses special facilities. An Amendment of the Act should be made to enable the Office to grant, in addition to the benefits at present obtainable:

1. An insurance for sickness pay to the age of 70 years, and burial-money.
2. Old-age pay commencing (*a*) at 65, and (*b*) at 70 years of age.
3. Endowments, or prospective provision.
4. Burial-money from 5*l.*

" *The stock or fund of Insurances shall alone be liable to make good the insurances made in it.*"

The endowments which the country was led to expect many years ago through the Post-Office, are a provision by which a member may secure for himself or nominee, by contributions paid monthly, a sum not less than 5*l.*, nor more than 200*l.*, at the end

of a term not less than seven, nor more than twenty-one years. They are but little known, but they afford an excellent means of securing a sum for outfit, marriage, apprenticeship, purchase of a cow, &c. I have known a cottage bought with the endowment. They are preferable to deposits in the savings-banks.

It is unnecessary to refer at length to the rules and regulations required for the management and administration of the above-named insurances, which the reader will find already recorded in the pages of this 'Journal.'* The conditions, however, relating to the sickness-pay and burial-money must again be stated, and the objections against the proposal to grant sickness-pay carefully considered.

The following rates are sufficiently high for securing the soundness of the sickness-pay and burial-money branch, good and efficient administration being obtained. For males 25 years old and under, sickness-pay till 70 and burial-money; and for males between the ages of 25 and 35 years:—

Class.	Payment per Month. Age 16 to 26 inclusive.	Payment per Month. Age 25 to 35 inclusive.	Sickness Pay per Week.	Burial Money.
	s. *d.*	*s.* *d.*	*s.* *d.*	£ *s.* *d.*
1	0 8	0 10	4 0	5 0 0
2	1 0	1 4	6 0	5 0 0
3	1 4	1 9	8 0	6 0 0
4	1 8	2 2	10 0	8 0 0
5	2 0	2 7	12 0	10 0 0
6	2 3	2 11	14 0	10 0 0
7	2 7	3 4	16 0	12 0 0
8	2 10	3 8	18 0	12 0 0

Example: A, aged 25, insures for 5th Class, viz. 12*s.* a week sickness-pay, and 10*l.* at death. For this he will pay 2*s.* a month, or 1*l.* 4*s.* a year.

B has turned 26, and will pay for the same benefit 2*s.* 7*d.* a month, or 1*l.* 11*s.* a year.

The tables published by the Post-Office do not offer old-age pay commencing at 70 years of age, but there could be no great difficulty in obtaining such benefits. Referring, therefore, to the table already published by me, I will merely take an example or two.

A, aged 25, insures for 5*s.* a week at 70, when his sickness-pay is to cease, and all contributions for benefits are also to determine. For this he must pay 10*d.* a month, or 10*s.* a year.

* See vol. viii. part 1, "Post-Office Insurances for Labourers."

Adding this to the cost of his sick-pay and burial-money, 1*l.* 4*s.*, his provision is secured for 1*l.* 14*s.* a year.

If he prefers his pay to commence at 65 at 5*s.* a week, it will cost him 1*s.* 5½*d.* per month, or 17*s.* 6*d.* per annum, which, together with his other insurance of 1*l.* 4*s.*, amounts to 2*l.* 1*s.* 6*d.*

The expense of this provision compares favourably with what he commonly pays into his club in certain districts of this country. The provision itself is, as I admit, of a humble kind, but meritoriously attained. Five shillings a week is a larger amount than the rate will afford him.

Many a man is hale and hearty when upwards of seventy years of age, and capable of making a fair day's work. "It would conduce to his health and happiness if he could take his work pretty much as it suited him. Labourers with a provision of this kind in store for them, with money payable at death, would be kept altogether from resort to the rate; and when totally incapacitated from work, relatives would prefer to make him comfortable at home, instead of leaving him to the care of the House."

My plan, it will be seen, is for a self-supporting system, and not, as erroneously supposed by the late Mr. Sotheron Estcourt, by whom the Commissioners were grievously misled on this point, a system which would entail a charge on the Revenue. The labourer, by paying no more than he now pays to his club, will have the certainty of a maintenance and a home of his own. It is no fallacious assumption to say that a percentage of careful and industrious men—small, if you will, for a time, but sufficient to influence many before long—will gladly avail themselves of the advantages placed within their reach. Once provide for them a system which has the element of durability in it, and the funds of which are protected and duly dispensed, being the property of the members, they will then have an inducement to secure their support, and consequently to promote their comfort and welfare, which has never yet been afforded the English labourer. The squire and clergyman will form and manage no more benefit societies; they will send their friends to the Post-Office;* and will cease to bolster up by misplaced kindness and subscriptions the benefit societies of the poor, which merely help them on the road to destitution. That the indirect but powerful influence, already noticed, of a better administration of the laws of relief would also expedite their attempts to provide for themselves, cannot be reasonably doubted.

* The cessation of the forming of new savings-banks is a parallel case. The Post-Office is preferred. The old private banks are on the decline.

But, admitting the excellence of the proposal to establish a system under the State supervision and control, and that, if attempted, it must be by means of the Post-Office, for reasons on which I need not now dwell, one or two objections remain to be disposed of, which, although noticed by the Commissioners, did not receive the attention they deserved.

They say that the main difficulty against the provision of sickness-pay by the State is the risk of imposition on the fund, and especially would such danger exist if losses were to be made good from the Revenue. My answer to the objection is, in the first place, that no pecuniary assistance from the State was ever contemplated in my proposal, excepting that I supposed, perhaps not unreasonably, that the annual expenditure already incurred by Post-Office insurances might not be grudged for a few years. To devote public money to the sickness fund would be the poor-rate in aid of wages in its worst form, though under another name.

The general impression is that the vigilance of the members of a small society is required in order to constitute a safeguard against malingering and fraud. Let us see what the value of such espionage is. It is allowed to be pretty strict, and unpleasantly particular. If the sick man "does but pick up a cricket-ball," he is, *ipso facto*, "out of benefit." If he rocks the cradle to keep the squalling infant still, while his harassed wife mixes the parish doctor's stuff for him to swallow if he can, and is detected by his neighbour whose duty is to watch him, he forfeits his pay. No Government supervision could look after sick members in this fashion. Nor is it necessary for the protection of the fund that such a watch should be maintained. The average number of sick persons in societies where this system of protection is relied upon is 27 per cent. in the year. On this statement being made a few years ago at the Society of Arts, an eminent actuary corrected the speaker by saying that 40 per cent. was nearer the mark in the village clubs * than 27. Compare this with the average number per cent. of sick persons in the year in two of the County Societies, which employ a different system, and one to be recommended for general adoption wherever the members are scattered over the country. The average of sick members in the County of Kent Friendly Society (established in 1828) is under 16 per cent. per annum. It used to be under 12 before the plan of Bounty grants was adopted, by which members, whose sickness-pay ceased on

* In Neison's Preliminary Report, 'Rates of Mortality and Sickness' (published 1881) the number of members per cent. who claim sickness-pay in the year in the Foresters is 23·449, and the average duration of sickness of each member is 5·8 weeks.

their attaining 70 years of age, or from sickness of upwards of 104 weeks' duration, are afforded half-pay in illness, which may last their lives. Notwithstanding, 16 per cent. is the average annual number of its sick list. The average of the Hampshire Friendly Society is about 7. This Society (founded 1828) probably owes the extraordinary reduction of the sick list to the adoption of the plan of the late Hon. and Rev. Samuel Best, whose labours will long be held in grateful memory. Mr. Best's plan, which the Commissioners thought somewhat elaborate,* provides an extraordinary check on claims for trifling illness, by making the member draw out, for each week's pay from the General Sickness Fund, a portion of a deposit paid by him to his separate account, and called his "rest." The adoption of Mr. Best's plan I should desire to see brought into use, if the Government will undertake sickness pay, but not at the outset.

It only remains to say that it is impossible for these two Societies to resort to the system of "espionage," on which the Commissioners place confidence. But, supposing that it were possible, who would be so foolish as to adopt a system which fails to secure adequate protection? The espionage of one neighbour over another cannot be compared to the means which these old societies have in use, and which will be found to be exactly adapted to the requirements of a sickness and burial-money branch of an institution managed by the State. No special inquiry was made by the Commission on this important and indeed vital part of the question; and the objection from the supposed risk of fraud has been repeated again and again by writers and speakers, who would be surprised to learn that the means of protection at the service of the State are not only far superior to those in common use, but are well worth the adoption of all well-managed societies, affiliated or other. If one did not notice the indisposition which commonly exists against altering a system, though defective and faulty, we should be surprised at espionage being in use in any but the worst-managed public-house clubs in this country.† The system is fully described in my Method, to which the reader is referred.

Again, there is the misapprehension that State action of this kind would entail great additional labour on district-postmasters. The management of a branch of fifty or sixty members, insured for sickness-pay, does not entail the trouble commonly supposed. There would be an average of six or eight members on the fund in the course of the year. Due medical supervision is secured

* "Exceedingly ingenious, but most artificial system."—*Report.*

† This answer refutes the "insuperable objection" which Mr. Scudamore maintained. (See his evidence, p. 163, &c., Third Report.)

by the man's doctor signing, in the first place, his declaration of sickness (to be sent to the agent), and from time to time initialling the form also supplied, stating its continuance. There are many cases in which the agent need not, for the purpose of security, visit the man more than once, though caution is always required. His duty is to see that the claim is fair, and to pay it. The payment may be made to any member of the family who is authorised to receive it, and will call for it weekly, or, as is oftener the case, at longer intervals. I may also notice that for the first few years in a new institution claims would be fewer than the average above given.

Lastly, the opinion that house-to-house collectors are required in order to keep the members punctual in their contributions, was insisted on, though Mr. Scudamore was not disposed to think that much difficulty would arise in providing a staff of collectors from the letter-carriers. The evidence relating to the necessity of collectors should, however, be qualified by other evidence taken by the Commission on the extraordinary payments which they receive, and the saleable value of their books.* The plan of having a system of fines for arrears, ending in forfeiture, due warning being given to the members to see that their monthly contributions are paid at the appointed time and place, works fairly well. The member will bring or send his money and receipt-card; and it will be his interest to take care that he does not sustain injury by neglect.†

Many alleged difficulties will disappear on careful examination, or prove to be of but little weight. I will mention one which relates to the maximum amount to which labourers should be allowed to insure for sickness. It should be restricted to five-sixths of his earnings in cash payments. These are far from being uniform in England. Where the money is less, there is an equivalent in house-rent, garden, fuel, &c. The common rate of cash payment in wages would govern the maximum sickness pay in any district, but the amount commonly insured for sickness in the clubs in the locality would also tell with sufficient accuracy how far the Post-Office should allow them to go. I provide for this by means of the Classes

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* The reader is referred to the evidence and the Report of the Commission on this question. Briefly, "a collector of 30*l*. a week would realise about 400*l*. a year, a very fortunate position for a man originally labouring at 1*l*. a week. The price of collector's books varies considerably, the highest figure in evidence being 675*l*." !

† "All who have to do with them agree that country labourers are the best possible members a club can have, the most punctual in their payments, and of a good average healthiness:—they require guidance and assistance to enable them to carry on a society on correct principles."—*Sir George Young* (Report to the Commission, p. 2).

in the Table at p. 169. In village clubs care is taken that the member shall not belong to more than one. The same restriction would be useful in the Post Office Friendly Society.

The advantages of my plan are—

1. A system of sickness-pay, burial-money, and old-age insurances, suited to farm and other labourers, which possesses the essential condition of durability.* "Nothing short of a national convulsion will affect it."—*Hon. E. Stanhope.*

2. It will afford a standard of good management and economical administration, and encourage the improvement of local societies, by which the welfare of their members will be promoted.

3. It will enable industrious and prudent men to secure independence by means of investing their money, now paid into benefit clubs and societies, which, either from their construction or mismanagement, or both, disappoint them in such effort.

4. Members removing from one part of the country to another may transfer their insurance to their new district.

5. Endowments, which have already been described, will be brought within reach of many persons of both sexes who will make good use of them.

That this Method, the cost of which is purposely taken at little less than that of the ordinary benefit clubs, may not only pay its way, but in time make *surplus* capital, of great use in future to the members, there must be good management, comprising the selection of the right sort of members, as well as careful administration of the funds, and safe investments of the capital. It did not receive the attention from the Commission to which its admitted importance gave it some claim. And as the improvements in the law relating to Friendly Societies, which the Commission recommended, fail to deal satisfactorily with the insurances of the poor, I may without presumption, as I trust, call attention to my proposal, in the belief that it will go far towards securing a remedy for the evils which still remain untouched by law. That the Commissioners were led to an erroneous conclusion, by the misapprehension of Mr. Sotheron Estcourt that the revenue would be chargeable thereby, and the error of Mr. Scudamore, on the presumed necessity of espionage for the prevention of fraud, any one who reads the evidence and their final Report, and will compare my proposal with the same, may satisfy themselves. Some thousands of the best of the labourers in this country would by this time have been rescued from a poor future had their decision been right.

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* This condition does not appear to have met with the attention of the Commission which it deserves.

"*The Poor-law* is the best benefit club, because everything is taken out and nothing paid in."

To give a rough outline of the origin of the Poor-law must be a matter of theory rather than of fact. But at a time when proposals are made to extend the area of rates from real to personal property, it may be of use to make the attempt.

Suppose then a community, to the members of which the occupation of country is assigned by the original owner, sufficient to secure the sustenance of each man by cultivating the soil. What will he do with his property? Among the new owners of the land a great variety exists in point of physical and mental abilities and of capacity. Some take almost naturally to the tillage of land, and succeed without much difficulty. Some were never meant to be farmers, and turn their abilities to other pursuits, by which it is quickly found that the general good of the community is promoted. Everybody agrees that the advantage of all will be consulted by providing that all should have a maintenance by labouring at the occupation for which they are best qualified; and on the understanding that their original claim to support from the soil should be reserved to them in case of their failure in their respective occupations other than agriculture, many resign their allotments of the land for various pursuits. In this agreement we have the germ of the Poor-law. If we examine the community further, and see how the agricultural part of it is working, a difference is soon perceptible between the cultivators of the soil. They speedily come to a re-arrangement of their property and a subdivision of labour. Some agree to take a third of the produce of the soil, and meet all claims on it under the original agreement, giving two-thirds to those who occupy their land. We may thus trace the institution of landlord and tenant. The latter in turn finds employment for labourers drawn from the increase of a community not as yet distressed by intestine struggles or foreign invasion, which will by-and-by compel the inhabitants to provide a costly and a strong Government for their own safety. New adjustments are required as time passes on. The ancient landmarks are obliterated, and estates of different extent cover the country. The ancient system of people being dispersed over the face of the earth is greatly interrupted by their finding the advantage of centres of population. The original claim of maintenance from the soil becomes well-nigh lost in the complicated community, and expenses begin to be thrown upon it which arise from causes foreign to the old agreement. There was not a very strongly-marked line between the merely incapable and the dishonest, and a short and summary method of disposing of

them both was in use. There was doubtless much to be said on the side of economy for the ancient method for the repression of crime, and the provision of the destitute. But the principle of duty between man and man would not suffer this injustice, and the provision of the destitute—a bare and hard one it must be admitted—was secured to them by law. How far a charge on the soil should be transferred elsewhere, and under what conditions personal as well as real property may be laid under contribution to maintain the destitute, is a question which need not be discussed here.* There can, however, be no doubt that the land has been saddled with charges which, together with the increased cost of labour, is more than it can bear. Possibly the remedy may be found in retrenchment of

* The following are passages from a memorial which has been sent to the Prime Minister from the Board of Guardians of Farnham and other places:—"At the present time real property has to bear the burden of (1) the county rates, which include a proportion of charges for prosecutions and police, benefits enjoyed by owners of every description of wealth; (2) the education of the poor as established under the Education Act of 1870; (3) the maintenance of paupers and relief of poor; (4) the lunatics; (5) the repair of highways; (6) the sanitary rates; and (7) pay a larger proportion to the Imperial Exchequer than personal property. That although the Imperial Exchequer contributes a proportion to the costs of the police prosecutions, of education, for maintenance of lunatics, and sanitary rates, the far heaviest proportion of the costs of all the above is borne by the land and houses (real property), which your memorialists would venture to suggest is unjust, as the real property is also heavily taxed by the Imperial Exchequer, and so contributes indirectly to the Government contributions in aid of local taxation. Your memorialists feel that the managers of the commercial world, stock and share proprietors, shipowners, bankers, money-lenders, merchants, &c., and every centre of acquired wealth derived from trade and personal property, should be called upon to contribute a fair quota towards the support of the poverty, the police and order of the country, the highways, the health, and education of the nation; but if the present system of rating of real property only for such purposes be compared with the basis on which the property and income tax is collected, it would appear that three-fourths of the wealth of the community altogether escapes or contributes but to a small extent to local government charges. This manifestly unfair system of taxing property invested in a certain form, and exempting it in others, tells severely on all engaged in the cultivation of the soil, and calls loudly for some modification in the law that shall tend to equalise the claims of imperial and local taxation on every description and class of wealth. The altered state of society of late years so induces our population to move about and mix together that the old-fashioned parish pauper is difficult to discover. The applicants for relief at the present day, being supplied from the various industries of all parts of the country, entail great trouble and expense in removals, whereas, if their claims for assistance were recognised by the public exchequer, no removals would be necessary, and the country at large would support the poverty and sickness of the nation wherever it arose. This is but one phase of the present unjust system of rating one class of property for the benefit of another, and the existing distress in the rural districts of the country prompts your memorialists in appealing to the Imperial Government for a full and fair investigation of the whole question of local taxation. Your memorialists therefore pray Her Majesty's Government will cause inquiry to be made by Select Committee or otherwise into the present unfair and partial manner in which the burden of local taxation is borne by a restricted portion of the community for the benefit and enjoyment of the nation at large."—'*Times*,' Dec. 14, 1881.

the expenditure, rather than levying a share of the revenue on property, the value of which is sooner or later affected by that of the land.

The student of the Poor-laws will notice that considerable departures from the principle of the relief of destitution, without reference to any other condition of the applicant, have from time to time been made. Hence some confusion in the administration of the laws of relief might be expected to arise, independently of local mismanagement. It is, indeed, no wonder that the objects of the care of the law have suffered, and that they have done what they could to get hold of the moneys of the rate, and make the best of their opportunities.

Poverty is no crime, nor is there any degradation in relieving men of honest and industrious habits, who are reduced to want. Such claims occur at times, and the unfortunate paupers are within their rights in demanding relief. In the same way, the worthless fellow who has reduced his wife and children to beggary, is equally within his right in claiming assistance. To relieve both and to ask no questions is the theory of the law, but there is a certain latitude permitted to the Guardians of the Poor in dealing with such applicants. The difficulty is how to relieve them, while they do not at the same time encourage pauperism and improperly swell the charges to the rate. A firm administration of the law of relief on the part of the Guardians and the Justices at Petty Sessions will do much to repress attempts at rate-plunder, and lessen, if it does not remove, the disposition to make them. But any radical defect in the law itself should be amended, and one has to record with regret that the remarks * of the Commission relating to the mischief of the Compounding Acts have not met with the attention from the Legislature which they deserve. The convenience of the collectors of the rate appears to be thought of greater importance than any possible mischief to the poor. It is again necessary to describe the working of a law which is injurious to more classes than the cottagers of this country. For the convenience of collecting the poor-rates and other rates by the same process, the owner of these tenements is allowed facilities, by means of which he

* "Nor has recent legislation been free from a mistake equally dangerous. By the Small Tenements Act, and the Poor Rate Assessment of 1869, owners of houses below a certain value are, in certain circumstances, rated instead of the occupiers. The latter therefore soon become indifferent to the amount of the rate, when they no longer feel its variation; and next, regarding it not as paid by them, but as a fund for their ultimate maintenance paid by the richer classes, they do not care to raise themselves above burthening it. . . . We think that in the interest of providence, as well as of economy, it is much to be regretted that so comparatively small a proportion of the people should be directly interested in the amount of local burthens."—Report, vol. iv. p. 190. Chap. vi. "On the Connection between the Poor Law and Friendly Societies."

can make a considerable profit out of the rates on his property. He may obtain a reduction, in some cases of upwards of 70 per cent. on the rental of his cottages. Certainly he has to run a risk, which is in practice very small. He must continue to pay rates for an unoccupied cottage. One is at a loss to know what adequate grounds exist for giving him his extraordinary advantage over all ratepayers. But this is not the worst part of the arrangement. It is liable to abuse, which tells badly with his tenants. They pay no rate: when a rate is made, it is the landlord's business, and he takes the liability into account in settling the rent of his cottages: *3d.* or *4d.* a week will be added to indemnify him for his expense and risk. It may easily happen that the occupier pays five times as much for composition as his landlord does for rates. On a revaluation of a district, there were certain cottages on which the rateable value was increased 1*l.* each. The additional amount of the rate to the owner might be 1*s.* a year on each cottage. The owner immediately gave notice to all the occupiers that in consequence of the increase in the rates they must each pay *3d.* a week more rent. Failing compliance, they were to receive a month's notice to quit.

Now if cottagers know that they are compelled to pay more in composition for rates than the rate would cost them, while the owner is assessed at little more than 30 per cent. of the rateable value of the tenements, what greater encouragement can be given to the common opinion that all poor persons should get as much as they possibly can from the rate itself, for which they pay so heavily and unjustly? It is fairly arguable that as much mischief has been done to perpetuate the demoralising influences of the Poor-law by the Compounding Acts as by supplementing the weekly wages of the labourer from the funds of the rate. So far as I have been able to notice, one of the best means of keeping the public opinion of the cottagers and small householders against resorting to relief, is to make them pay their rate as it falls due; and the smaller the amount they are called upon to pay, the more sturdily do they reprobate the conduct of those who have become paupers and cause them expense. No opinion adverse to rate-plunder is probable wherever the Compounding Acts are in force. If a step in the right direction is to be taken, they should, for the social and moral good of the poor, be swept away. One venerable authority, Mr. Henley, who is yet spared to his family and friends, many years ago denounced in the House of Commons the Small Tenements Act as a device of Old Nick. The device is still retained, on account of its convenience.

What probability, however, there is of obtaining the abolition

of the Compounding Acts may be estimated by recent legislation, in which the same principle of convenience has overridden other considerations. The evil of providing for the cost of education by means of the Poor-law machinery has been denounced on account of its pauperising tendencies on the young.* Surely had there been due care to guard against the further demoralising of the poor, the method of supervising and paying the cost of their education which is now in use would have been avoided. There is ground for apprehension that the State action which offered the insurances they require may be in danger of the same mischief. The Commission note this possibility. It is essential to the good of the poor that the system of benefiting them by insurances should be kept as distinct from that of poor relief as light from darkness.

There can be no question that the administration of the poor relief has of late years become more careful and intelligent than formerly. The conferences of Chairmen and other Guardians have done much to bring about improvement. A strict administration as to out-relief and compelling relatives to assist in the maintenance of paupers have a certain effect in deterring applications for relief. The poor are none the less cared for, while they are at the same time impelled in the direction of thrift.

The knotty point of the treatment of applicants who are members of Friendly Societies was in no way cleared up by the Commissioners, who, in answer to inquiries addressed to Boards of Guardians, found every variety of practice. Some Boards never

* "THE PAYMENT OF SCHOOL FEES.—A deputation from the Manchester and other School Boards, Boards of Guardians, and School Attendance Committees waited upon Lord Spencer and Mr. Mundella at the Education Department, to urge their views in favour of placing in the hands of the local School Authorities the duty of paying the school fees for necessitous, but non-pauper children.

"Mr. G. Milner, of Manchester, said that as the law now stood, the duty of enforcing school attendance was placed on the local School Authority, while that of paying the school fees for the children of the needy, but non-pauper, poor was laid upon the local Guardians of the Poor. The necessity of application by the non-pauper, yet poor parents to the Guardians of the Poor, was attended by harassing vexation and many evils. It was an outrage on the feelings of the poor, but still respectable portion of the people, and involved a loss of time and caused irregularity in attendance. The deputation also desired to represent that the Guardians of the Poor in Manchester and Chorlton were anxious to be relieved of this duty.

"Mr. Mundella, who in the course of the discussion had remarked that if any voluntary school refused to receive ragged children, he should at once cut off the grant, said he quite sympathised with the desire of the deputation to avoid bringing parents who were not paupers, in direct contact with the machinery of pauperism, and he should be glad if Boards of Guardians were no longer educational authorities; but he must obey the law, and he had to deal with them as educational authorities.

"Lord Spencer pointed out to the deputation that an Act of Parliament would be necessary in order to deal with the grievance.—*Times*, July 13, 1881."

recognise, in granting relief, the weekly income received from the club; others do so only to half the amount of the sick pay; others treat it as property, and diminish the relief given accordingly. Medical relief only is allowed in some Unions; in others, the sickness-pay is regarded as specially intended for the head of the family, and the ordinary amount of relief is given to the wife and children. They believe that so far from habits of providence being encouraged by the Guardians making a distinction between sickness provision and other property, "the opposite effect is more likely to be produced." "If two cases similar in every other respect presented themselves (the one that of a man in a club, the other not) it would no doubt be advisable to draw a distinction in favour of the provident man," but they "think it impossible to lay down any rule in the matter which should not conflict with the principle of the Poor-law, that every person has a legal right to have his necessities relieved, without regard to his deserts." They think that "relief cannot depend upon any such adventitious circumstances as a membership of a Friendly Society." The Commissioners also note that the favour shown to members of one kind of Friendly Society must be shown to all, for the Guardians have no means of discriminating between good societies and bad.

Surely, as a means of aiding the Guardians in deciding on the kind of relief to be given, the information about the insurance of the applicant and the description of club to which he belongs, are important. They have a right to know what sort of applicant they are dealing with, fully conceding that he is to have relief in accordance with the principle of the Poor-law. Shall it be out-relief, or the House, for instance? If he is a worthless fellow, who lets his wife and children starve while he has been drinking or gambling, the Guardians will not be likely to give him assistance other than the House. The treatment is different of an applicant who is under the visitation of illness in his family or other distress, and who is known to be a respectable man. The Board would not order him the House. In either case the relief is given, but it is one of the advantages of local administration that some discretion as to the mode of relief is vested in the Board. It is greatly to be regretted that, in the case of applicants who are members of benefit clubs, no information to enable Guardians to discriminate between good and bad societies has been forthcoming in consequence of the labours of the Commission. No greater encouragement could be given to the establishment and management of good clubs, and to the discouragement of unsound ones, than the knowledge on the part of the applicant that it would not be in his favour if he came before the Board as

a member of a society which failed to fulfil the conditions required by law, or which was so framed and managed as to pauperise its members.

On the mere ground that the information would be serviceable to the Guardians, but not forgetting its far greater service to the poor, I desire again to draw attention to my suggestion, which elicited the approval of four of the Commissioners, namely, Sir M. Hicks Beach, Mr. Bircham, Mr. Patteson, and the lamented Mr. Evan M. Richards, "that there should be a local publication of societies, distinguishing good from bad."

"We are not unmindful," say these gentlemen, "that there may be border cases, and difficulty in drawing the line between those societies which may or may not be entitled to the better-class certificate. But it is the very end of all the additional care which is recommended that the line should be drawn and the distinction established by some one; and if it be difficult for the Registrar, with all his means of knowledge and discrimination, to do it, we apprehend that the task will be, as heretofore impossible, for the poor and ignorant, and that we shall continue to have a large majority of our societies, although there may be vast numbers constantly joining them, insolvent and unequal to their engagements. Whereas there might be in the simple tangible fact of a discriminating certificate something which the poorest and most ignorant could appreciate, something which might point them to the good and guide them from the bad. . . . . We are aware that objection to this course will be more or less widely entertained, on the ground that in adopting it the State would incur undue responsibilities." After answering this objection, which the Commission generally appear to have been much more concerned about than they need, for there is very little in it beyond supposition, they continue. . . . "It seems to us that the State will undertake a far greater responsibility if it shrink from the simplest mode of informing the public what in its opinion are good and trustworthy societies. Even the educated public are, and are likely to continue, far too ignorant of these matters to justify an opinion that the mere publication, without criticism, of tables, accounts and reports will, for practical purposes, show the difference between the good societies and the bad. We are therefore opposed to stamping good and bad with the same registration mark, and are clearly of opinion that the open discrimination which we suggest may be undertaken with risk and with great public usefulness, especially if when publishing *in the respective local districts*" such particulars founded on the returns and valuations of societies as they may deem fit, "the Registrars with every available frequency set forth that :—

"(1) No certificate implies a guarantee of solvency.

"(2) Class A comprises societies which have conformed with all requirements of the law, and are acting upon tables of contribution and benefit approved for their use. . . .

"We are of opinion that it would presently come to pass that all societies would be divided in an appreciable manner into two classes only, societies presumably sound, 'Class A,' and societies as to the soundness of which nothing could be predicated. . . . As a better understanding of the whole subject advanced, these societies would respectively gain and lose favour with the public accordingly." I may be allowed to add, that the best publication would be by way of annual advertisement of a list of societies of "Class A" in the local newspapers, which would thus keep the members informed of that of which they would probably hear nothing through the Reports on Friendly Societies.

In the event of a National or Post-Office Friendly Society being offered to labourers, membership in the same, or in any society of Class A, would not tell to the prejudice of any applicant for relief. That applications will be occasionally made from some unfortunate persons whose insurance provision is unexceptionable, is but too probable. The Guardians would know how to deal with them. Their line of action would lose the charm of variety, and we should have uniform treatment in lieu of disorder and error. One is at a loss to know how this could conflict with the principle of the Poor-law, "that every person has a legal right to have his necessities relieved, without regard to his deserts."

Inasmuch as we cannot hope to obtain another system of relief for the destitute in lieu of the Poor-law, let us try to improve it, wherever it is shown to be deficient, and administer it as well as we can. But together with a strict and wholesome administration of the relief, let the assistance of the State be no longer withheld in providing the care, supervision, and management which the poorer class of labourers of this country greatly need, and which in time they would value highly. I have shown that the sums they contrive to pay for their benefits, so called, are sufficient, if duly secured to them, to provide an independence, humble indeed, but far superior in every way to that maintenance which they may claim, when nothing else remains, from the State. Such a provision as is here pleaded for them, being honestly acquired by their own exertion and prudence, will raise the moral and social character of the poor in a remarkable degree. This is no mere theory, but matter of experience, though far from common among them. I have again called attention to the superiority of this system to that in common use, for the due protection and administration of the sick fund ;

and I lay some stress on the omission on the part of the Commissioners to institute any examination into it, and report upon the same, with a view to its adoption. I further submit that such a system having been in satisfactory use in certain counties for considerably more than half a century is as well adapted to the whole of the country as to any portion of it, and may with advantage be so adapted. The defects in the Poor-law which the Commissioners noticed, relating to the incidence and collection of the poor-rates on cottage occupiers, are again urged on public attention. Certain facilities by which an improvement may be obtained in the mode of dealing with applicants for relief who are members of benefit societies, have also been pointed out. It is necessary to add that nothing has been done to carry out suggestions relating to the Poor-law and to the extension of insurance other than sickness-pay, through the Post-Office, which met with the approval of the Royal Commission.

The appeal made in these pages for the support of those who may have viewed with groundless alarm efforts to extend the benefits of insurances suited to the labouring classes, will not, it is hoped, be altogether in vain. The claim for their assistance can be placed on no lower ground than the right discharge of our common duty to those whom we have always with us, "the poor, who will never cease out of the land."

APPENDIX.

At the Conference on Thrift, held at the Mansion House on the 20th of May, 1881, under the Presidency of the Lord Mayor, it was resolved "that it is desirable to use the existing machinery of the Post Office for providing, on sound economical principles, a cheaper, safer, and simpler means of industrial insurance than at present exists." The proposal to establish sickness-pay was not discussed on the occasion.

Memorial as follows:—

TO THE RIGHT HON. THE CHAIRMAN OF THE FRIENDLY SOCIETIES' COMMISSION.

The Memorial of the Undersigned
Showeth,

That in view of a strict and wholesome administration of the laws for the relief of the poor, together with the advancing rate of labourers' wages, the provision of a self-supporting system of Insurance for Sickness and Old Age, and for Burial Money is, in the opinion of your Memorialists, of importance to such labourers as are at present upon the verge of pauperism, and who

might avail themselves of the same at a cost not exceeding the amount now expended by them in unsound and uncertified Benefit Societies.

That your Memorialists therefore respectfully urge on your attention ;

(1.) That the provisions of the 27th & 28th Vict. cap. 43 should be extended in such a manner as to offer to industrious labourers insurances suited to their requirements under the supervision of Government and by means of the Post Office.

(2.) That the alleged difficulties relating to Sickness Pay will be found, as your Memorialists believe, to have been exaggerated, and are not of such a nature as to prevent the management and administration of sickness-pay being undertaken and efficiently discharged by the Post Office.

(3.) That the proposal to grant Endowments through the Post Office should also receive the support of your Commission.

(4.) That your Memorialists further submit that the Certificate of the Registrar of Friendly Societies should be so amended as to make it of weight in determining the trustworthiness of Friendly Societies.

(Signatures following.)

At a Conference of Chairmen and Vice-Chairmen of Boards of Guardians in Dorset, Somerset, Wilts, Devon and Cornwall, held at Bristol on November 29th ult., under the Presidency of the Earl Nelson, the following resolution was carried unanimously :—

"That in the opinion of this meeting if the Government could provide an Insurance Society for Sickness and Old Age for the wage-earning class, it would be a most effectual mode of checking pauperism and of ultimately reducing it within very narrow dimensions."

(Signed) NELSON.

Similar resolutions were passed at other Poor Law Conferences.

Advantages under the amended law 1875, now afforded to Registered Friendly Societies.

A Society registered under the Friendly Societies' Acts has the following advantages over an unregistered Society for the like purposes.

(1.) It can legally hold land and other kinds of property in the names of trustees, such property passing from one trustee to another, except in the case of Stock in the Funds or copyholds, by the mere fact of their appointment, and can carry on all legal proceedings in the trustees' names.

(2.) Whilst the only criminal remedy against fraud by its members open to an unregistered Society is confined to larceny or embezzlement, a registered Society has a remedy on summary conviction whenever any person

1. Obtains possession of any of its property by false representation or imposition ;
2. Having possession of any of its property, withholds or misapplies it ;
3. Wilfully applies any part of such property to purposes other than those expressed or directed by the Rules and authorised by the Act. The penalty being a fine not exceeding 20*l.* and costs, and in default of payment imprisonment, with or without hard labour, for not exceeding three months.

(3.) If an Officer of the Society dies or becomes bankrupt or insolvent, or if an execution is issued against him whilst he has money or property of the Society in his possession, by virtue of his office the trustees of the Society are entitled to claim such money or property in preference to any other creditors.

(4.) If the Society has Stock in the Funds in the names of trustees, and

a trustee is away from the United Kingdom, becomes bankrupt, &c., or a lunatic, dies or has been removed, or if it is unknown whether he is alive or dead, a registered Society, instead of having to apply to the High Court of Justice, or to take any other proceedings, which it would have to do if unregistered, can have the money transferred by direction of the Chief Registrar on payment of 1*l.* fee.

(5.) The documents of the Society are for the most part free from stamp duties.

(6.) The Society can admit members under 21 (but above 16) and take binding receipts from them, which would otherwise be of no effect.

(7.) In a registered Friendly Society the Certificates of Birth or Death of members, or of any other persons insured, or to be insured with it, cost only 1*s.*; or when several certificates of the same death are applied for at the same time, 6*d.* for any certificate after the first.

(8.) A registered Society has the privilege of investing money with the National Debt Commissioners.

(9.) It has certain special privileges in the holding of copyhold property.

(10.) If it invests money on Mortgage, such Mortgages can be discharged by a mere endorsed receipt without reconveyance.

(11.) Its officers are legally bound to render account and give up all money or property in their possession on demand or notice, and may be compelled to do so either by the County Court or the Magistrates.

(12.) Disputes may be legally settled according to the Society's own rules (unless in the case of certain collecting Societies), or if no decision is made within forty days after a decision is applied for by the County Court or the Magistrates, or if both parties desire it, and the rules do not forbid, by the Registrar of Friendly Societies.

(13.) Members of registered Friendly Societies have the privilege of legally insuring money on the deaths of their wives and children for their funeral expenses, without having an insurable interest in their lives (such insurances are void by Act of Parliament, if effected with an unregistered Society).

(14.) Members of Registered Societies may (unless in benevolent Societies or Working Men's Clubs) dispose at death of sums payable by the Society not exceeding 50*l.* by written nomination without a Will, and this nomination may be made by youths of 16, who cannot make a Will till they are 21.

(15.) Where there is no Will and no nomination, the trustees may distribute sums under 50*l.* without Letters of Administration being taken out (a person who should do so in any other case would make himself liable for the debts of the deceased).

(16.) The Society is entitled, without being in anywise compelled so to do, to call in the services of the Public Auditors for the auditing of its accounts, and those of the Public Valuers for the valuing of its assets and liabilities, at fixed rates of fees.

(17.) Its rules, and other important documents relating to it, are placed on record in a Public Office, from whence authentic copies can be obtained, which are evidence in any Court of Justice. This is of great consequence in proving title to land, and in cases of prosecution by the Society.

No fee is payable on the registry of a Friendly Society, a Benevolent Society, a Working Men's Club, or a Cattle Insurance Society, or a branch of any such body, or on the registry of any amendment of its rules (which must, however, be supported by a statutory declaration), or of any notice of change of Office, or of the appointment of trustees.

Institutions formed since 1875 for extending safe insurances to labourers, and otherwise improving the facilities for such insurances.

NATIONAL PROVIDENCE LEAGUE.

For Promoting National Compulsory Insurance against Destitution in Sickness, Infirmity, and Old Age.

President: The Right Hon. the EARL OF SHAFTESBURY.

Treasurer: Captain W. H. MOSELEY, Ashley Arnewood, Lymington.

Secretary: J. L. UTTERTON, Esq.

Offices: Lancaster House, The Savoy, Strand, London, W.C.

London, *March*, 1880.

The large amount of public attention which has been directed, both in this and other countries, to the subject of National Insurance (as a means of assuring individual independence, and thus diminishing Pauperism), as well as the wide acceptance among thinking men of the principle at least of the proposal, has led to the formation of the "National Providence League." Its objects are to disseminate information and create opinion in favour of some such measure of National Insurance as that set forth by the Rev. W. Lewery Blackley in his writings on the subject.

The Council ask assistance for the objects of the League in any or all of the following ways:—

1. By joining or co-operating with the Central Council in London, and the various County Committees, and by aiding the cause by personal influence and by public or private advocacy.
2. By contributing donations and annual subscriptions in aid of the expenditure of the League, which must be necessarily large, as, in order to bring prominently before the national mind the importance of the subject, much information must be published and distributed gratuitously. It is also intended to organise committees in each county, and to arrange for lectures and discussions on an extensive and systematic scale.

NATIONAL PROVIDENT ALLIANCE OF REGISTERED FRIENDLY SOCIETIES.

Established 1878.

President: Rt. Hon. Sir STAFFORD NORTHCOTE, Bart., M.P.

Vice-President: WYNDHAM S. PORTAL, Esq.

Secretary: Mr. FOX, Winchester.

OBJECT.

To facilitate and develope the work of Friendly Societies:

a. By promoting Mutual Agency and Correspondence between Societies in Alliance.

b. By offering to Managers and Members the means of conferring and advising together on subjects requiring mutual assistance or the attention of the Legislature.

Societies join for all or some of the following purposes, viz.:—

1. Supervision during Sickness of Members of one Society when residing in the District of another.
2. Enquiries as to Parties claiming Benefits.
3. Payment of Sick-pay, Burial Money, or other Benefits.
4. Medical Attendance.

VI.—*A Joint-Stock Farm in the Netherlands.* By H. M. Jenkins, F.G.S., Secretary of the Society, and Editor of the Journal.

[Reprinted from the 'Report on the Agriculture of the Netherlands' to the Royal Commission on Agriculture.]

This farm is situated in the northern portion of the island of South Beveland (Zeeland), and is described here as an illustration of the success which may attend the judicious application of capital to the reclamation and cultivation of land.

In the year 1809, 23 merchants of Rotterdam formed themselves into a company, and purchased of the Government, at a public sale, a tract of land which was under water at high tide, but exposed at the extreme ebb. The price paid was 650,000 guilders (54,000*l.*), and half a million guilders (over 40,000*l.*) were spent in building sea walls, making a canal, and doing other necessary works for the protection and drainage of the land. The total capital of the company is 1,500,000 guilders (125,000*l.*), of which the balance, about 30,000*l.* (360,000 guilders), is employed as farm capital. The total extent of the polder * is 1600 hectares (4000 acres), but about 150 hectares belong to other proprietors, including one discontented shareholder, who was paid out in land. There are now 70 shares held by about 30 shareholders or more.

The amount of profit on these 1450 hectares (about 3600 acres) divided annually between the shareholders, in the years 1870 to 1878 inclusive, averaged 110,000 guilders (over 9000*l.*). These figures may be summarised as follows:—

Capital employed on 3600 acres, 30,000*l.* = 8*l.* 6*s.* 8*d.* per acre.

	£
Land and dykes, &c., cost 94,000*l.* at 4 per cent. (equal to rather more than 1*l.* per acre)†	3760
Capital 30,000*l.* at 5 per cent.	1500
	5260
Deduct above from total profits	9000
Making farmer's profit of over 1*l.* per acre, or more than 12 per cent. on the capital of 30,000*l.* ..	£3740

This result will doubtless astonish some English farmers, and it will be useful to describe the operations by which it has been

* A polder is a tract of land brought into cultivation after having been protected from inundation by means of embankments.

† In comparing this rent with that paid by tenant-farmers, it should be remembered that the company have to pay the polder taxes and the land tax, whereas the tenant-farmers do not. It will be seen that the polder taxes alone amount to an average of over 15*s.* per acre.

obtained. In the first place, I should state that by common consent the success of the farming is chiefly due to the ability, knowledge, and energy of the director, Mr. G. J. van den Bosch, to whom I am very much indebted for submitting to a prolonged cross-examination on the facts and figures which I have already given, and those which I am now about to state.

The land is an alluvial clay with generally a sandy subsoil, and when it was first reclaimed the ditches necessary to carry off the water occupied 9 per cent. of the entire surface. The polder, however, is above the level of the sea at low water, and advantage has been taken of this to carry off the land drainage by means of a self-acting sluice at the sea wall. This sluice opens by the pressure of the inland water at low tide. Thus the expense of pumping has been avoided. This fortunate situation has enabled pipe-draining to be used; and from 1852, when this kind of drainage was commenced, to 1878, nearly 2400 acres were drained, and 200 acres of surface, formerly occupied by ditches, were brought into the cultivated area. The drains are about 4 feet deep, and the cost of the work has averaged nearly 12*l.* per hectare, or 4*l.* 16*s.* per acre. On the average, the company spends annually about 2500*l.* in drainage and other improvement works, but the exceptional season of 1879 did so much damage that it was found necessary to borrow about 8000*l.* to carry out works of reparation of pressing necessity. The repayment of this sum, with interest, will of course affect the balance of profit available for payment as dividend to the shareholders for the next few years.

Of the 3600 acres belonging to the company, all but about 250 acres are comprised in the Wilhelmina Polder, properly so called. The small remnant is a portion of the East Beveland Polder, which is one of those known as a "*polder calamiteuse.*" The maintenance of that polder is undertaken by the Government, and the proprietors can be compelled to pay any tax that may be levied by the State for such maintenance, up to a maximum of one-half of the rent value (with 20 per cent. added, minus the land tax). Thus, a piece of land in this polder worth 100*l.* per annum would be charged, say, 6*l.* as land tax. One-half of the difference would be 47*l.*, and 20 per cent. on the assumed net value would be nearly 19*l.* Thus the maximum amount of polder tax payable would be nearly 66*l.* per annum on land worth 100*l.* per annum to rent. If the cost of maintaining the land and the dykes in proper condition exceeds this sum, the surplus is paid by the State.

With the exception of this isolated portion of 250 acres, the cost of maintaining the dykes and other drainage machinery of the Wilhelmina Polder varies from about 13*s.* to 17*s.* per acre

per annum (20 to 25 guilders per hectare). In addition to this, the owners of the Wilhelmina Polder, having a contingent interest in the maintenance of the East Beveland Polder, are taxed to the extent of about 1*s.* 3*d.* per acre per annum for the maintenance of the latter.

The farm is divided into rectangular fields of from 20 to 25 acres each, separated by neatly trimmed thorn-hedges, and they present a perfect picture of agricultural neatness and symmetry. The absence of the ditches, which are so general in the Netherlands, and several other features which will appear in the following pages, made one think more of Holderness than of Holland; but I was assured that I was the first Englishman who had ever visited the Wilhelmina Polder.

Of the 3600 acres of land belonging to the company, about 3000 are under the plough, and the remainder in permanent grass, with the exception of the small portion required for labourers' cottages, gardens, and potato ground.

When first reclaimed, colza (rape-seed) is generally the crop first taken; but in some cases the land is so salt that it must be pastured for some time. Afterwards, the rotation on the lighter land is a seven-course, viz. (1) turnips, (2) chevalier barley, (3) vetches, (4) rye, (5) potatoes, (6) beans, (7) rye. Between 30 and 40 acres of lucerne are also sown on the light land in the beans, and the crop remains down 7 years, then going again into the rotation.

The heavy land is cropped on a course of 21 years' duration, including 2 years' seeds and 2 years' red clover, the following being the usual succession of crops:—(1) peas, (2) wheat, (3) roots, (4) beans, (5) wheat, (6) oats and red clover, (7) red clover, (8) peas, (9) winter barley, (10) beans and carraways, (11) carraways, (12) carraways, (13) peas, (14) wheat and red clover, (15) red clover, (16) oats, (17) roots, (18) beans, (19) wheat and artificial grass, (20) grass, (21) grass.

The mixture of seed sown is about 35 lbs. per acre, of which one-half is clover seed (viz. a little red, but mostly white, hybrid, and yellow), and the remaining half is a mixture of rye-grass and Timothy. About 25 acres of the grass is mown annually, and the rest pastured by cattle and sheep, the former being on from May until the end of July or beginning of August. Each shift on the heavy land consists of about 135 acres, so that the light arable land cannot measure more than about 170 acres. The "root-crops" consist of 112 acres of mangolds, 15 to 18 of turnips and swedes, 50 of flax once in the rotation, 20 of maize, a few acres of cabbage, 70 to 100 of potatoes, 35 to 50 of sugar-beet, and 50 acres let to the labourers. The sugar-beet is sold to the sugar factories, and in 1879,

45 acres were grown and gave an average yield of only 10 tons per acre, whereas the general average is 16 tons. The price obtained is only 16*s.* 8*d.* per ton, but then Mr. van den Bosch buys back diffusion pulp at 5*s.* per ton, and press pulp at 10*s.* per ton. In 1879 he stipulated for 600 tons of the latter at that price, so that he actually bought one-third more feeding-material than he sold, and at a very advantageous price.

As maize is rarely grown in England as a fodder crop, it may be well to state that the land is prepared as for mangolds. The stubbles are steam-cultivated after harvest, and ploughed by horses or steam in November. At the end of March the land is harrowed, and in April it is put in ridges. Fourteen tons per acre of farmyard-manure is generally used, but sometimes a smaller quantity supplemented by dissolved guano. As a rule, however, dissolved guano, or a mixture of dissolved bones and nitrate of soda, is only used for wheat or oats, at the rate of a little more than 1½ cwt. per acre.

It will be noticed that peas are grown after carraways and after seeds. In the latter case they are a blue sort, and last year this was the only crop that fetched a high price. These blue peas are extensively used for domestic and naval purposes, and as the yield is nearly 40 bushels per acre, the return is highly satisfactory. About 3 bushels per acre are drilled by a Hornsby's machine. They are first horse-hoed, then hand-hoed several times at a cost of 4*s.* per acre each time. The same system is applied to all crops except roots, which are horse-hoed several times.

The peas are gathered about the second week in July, and the land is steam-cultivated and crossed soon afterwards, harrowed, and left for the weeds to rot. In the middle of September it is ploughed and harrowed, and in October drilled with wheat or winter barley, the seed being harrowed in. Mr. van den Bosch sows either Essex rough chaff, Rivett's, or Zeeland wheat, using 6 pecks per acre; and he finds that the first gives an average yield of 6 to 7 bushels per acre more than the native sort, but it is more liable to sprout in wet harvests. A good crop is 45 bushels, but in some years it measures more.*

Harvesting is done partly with the sickle and partly with machines,—Hornsby's, Howard's, Samuelson's, and Johnston's being all in use. The cost of reaping with the sickle is 8*s.* to 10*s.* per acre, including sheafing, binding, and stooking, which operations alone cost about 3*s.* 4*d.* per acre when the crop is cut by machine. During harvest a labourer can earn 15*s.* per week, his wife 10*s.*, and a child up to 5*s.*

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* In 1874 the crop of wheat averaged 50 bushels per acre.

Roots are not fed on the land, but are carried and stored in October and November. After having been manured, the land is ploughed by horses; in the spring it is harrowed and drilled with beans 14 to 16 inches apart, there being one row of carraways between each row of beans. A little over 3 bushels of beans and about 5 lbs. of carraway-seed are used per acre. The carraway being a biennial plant, it does not give a crop the same year as the beans, but its after-cultivation is very economical, as it consists simply of horse-hoeing and hand-weeding. The only difficulty consists in harvesting the seed, as it is so liable to be shed, especially in sunshine or very dry weather. Consequently, so much seed is shed that it is generally found profitable to take a second, being a self-sown, crop on the same land the following year. The crop amounts to from 10 to 12 cwts. of seed.

The preparation of the bean and carraway stubble for wheat is the same as that just described in the case of the pea stubble, while for oats the wheat stubble is either steam-cultivated once, or ploughed two or three times by horses. Oats are sown towards the end of March, 2 bushels of seed per acre being used, and an average crop would be from 55 to 65 bushels.

Cattle.—There are 350 cattle of all ages, namely, 80 cows, about 80 feeding animals, viz. 20 cast cows, 20 heifers, and 40 bullocks; 40 two-year-olds, 70 to 80 yearlings, and 80 to 90 calves. The calves drop all the year round, and the milk is sold in the neighbouring town of Goes at 8 cents per litre (about $7\frac{1}{4}$*d.* per gallon). The bulls are either pure Shorthorns or a cross of Shorthorn and Dutch. The system is to take three crosses of pure blood and then to use a cross-bred bull. Mr. van den Bosch is now about to buy some North Holland cows, in order to get fresh Dutch blood. The cross-bred cows milk as well as the pure Dutch, and the production of milk in the herd averages about 600 gallons per head per annum, although he cannot put them on grass. His neighbour, with similar cattle, obtains 775 gallons per head, as he has some good grass-land. The cows are milked morning and evening, and their food consists in winter of cut straw with pulped mangolds, beetroot pulp, and 9 lbs. per diem of cakes made of ground linseed and pea-, bean-, and maize-meal, all steamed together and made into cakes on the farm. In the summer they go on the artificial grass. He finds hay the most expensive of all foods, and therefore has left off using it for cows, but reserves it for calves and young bulls. Calves never suck their dams, but get milk for three or four months, gradually more and more skimmed.

Sheep.—The flock generally consists of 850 ewes, as many lambs, and as many feeding sheep (including about 300 to 350 cast ewes), thus making a total of about 2500 sheep. The

breed is a cross of various degrees between the Lincoln and the Flemish, and has been in existence for many years. Lambing begins about the middle of February in sheds; and ewes until that time get mangolds and pulp, with an allowance of oats for six weeks, and whenever possible they take a daily turn on the pastures. During the lambing season they have also a portion of hay. As shown already, the produce does not average more than a lamb to a ewe. The lambs are weaned when four months old, and are put on red clover until the end of July, when the ewe lambs go on the grass-land of the dykes, where they remain until the next summer, except that in winter they are housed in the sheep-sheds, and fed on mangolds, hay, straw, and pea-haulm; and in very severe weather get also an allowance of oats. The feeding sheep are moved from the red clover on to the mixed seeds, and get oats until January. In September the mixed seeds become more or less exhausted, and then the sheep get cabbages upon them. In the sheds, where they are housed at night, and in bad weather from the middle of October, they get pulp, pulped turnips, and kohl-rabi; but in January, the turnips and kohl-rabi being exhausted, they get mangolds and pulp; and one home-made cake between 5, *i.e.* $\frac{3}{5}$ of a lb. per head per day; but this quantity is increased a little. In May, the feeding sheep are put upon red clover until they are sold, in the beginning of June, to go to Deptford.

The prices at Deptford are said to be lower than those ruling at Islington, to the extent that it is now sometimes more profitable to send the sheep to France. This was especially the case in the autumn of 1879, and the same remark holds good for cattle. In fact, the price of cattle was then so low that practically none went from Zeeland to England.

The average yield of wool, which is never washed, is 8 to 10 lbs. of unwashed wool per head over the whole of the flock.

Pigs are now being done away with, as the bulk of the milk is sold, and what skim-milk there may be is wanted for the calves.

Horses.—There are 96 working horses kept on the farm, and six pairs are hired from some tenants of the company who rent grass-land and keep 8 or 10 cows, and add to their earnings by working themselves and with their horses on the company's farms. In winter, horses are kept entirely on straw unless they are at work, when they get some of the home-made cakes also. During the summer they receive up to 15 lbs. of cake each per diem with red clover; and at night they are turned out to grass. In the autumn they have, in addition to cakes, mangolds and clover-hay; in the spring only clover-hay and cakes. Beans

and oats are added during harvest time. From 10 to 15 horses are bred annually, and are brought into work at four years old. On March 1st, 1879, there were 10 three-year-olds, 9 two-year-olds, and 15 yearlings.

Labour.—On a farm where nearly 200 people are employed all the year round, and where more than 250 are employed during the harvest, the labour question must be one of serious importance. It will be seen that even on a farm so thoroughly well-managed in all respects, the Dutch labourer is here also in a very inferior position to his English representative.

The current rate of wages is about 10*s.* per week in the summer; but from December 1st to February 28th, they are about 1*s.* per week less. Women earn a trifle more than half those sums. The ploughmen, who live in the bailiff's houses, are divided into five classes:—the head ploughman gets from March 1st to December 1st, 15*l.*, with food and lodging; the second, 12*l.* 10*s.*; third, nearly 11*l.*; fourth, 9*l.* 3*s.* 4*d.*; fifth, 7*l.* 10*s.* The bailiff is allowed 4*s.* 6*d.* per head per week to pay for their food, which consists of bread and bacon in the morning, potatoes and pork for dinner, and milk, soup, and bread in the evening. The ploughmen are kept and fed during the winter to attend to the horses and cattle, and they generally receive from 13*s.* to 17*s.* as a present.

The hours of work are from 6 A.M. to 6 P.M., but during harvest they work until 8.30 P.M. They take their meals into the fields with them, and the day is divided as follows:—Work from 6 to 8 A.M., then from 8.30 till noon, then from 1 P.M. till 4, then from 4.15 until 6 P.M.

The rent of cottages varies from 1*s.* to 1*s.* 8*d.* per week, and the best of them consist of one room about 13 feet square. On one side are the windows and the door, on the opposite side are two box-beds with a cupboard between, and on one of the two remaining sides is a fire-place. The side opposite the fireplace is blank, unless the wall is broken by a door leading into the lean-to outhouse, in which fuel, potatoes, and other such matters are stored. The pigstye and the privy are separated from the cottage, and are small wooden erections. Some of these cottages have a kind of loft above, in which the labourers store hay, straw, &c. Those with large families who have this additional accommodation utilise it as a sleeping-place for the elder children, who sleep on the hay and straw. If there are many children in a cottage without a loft, four are stowed into one bed by placing pillows at each end. Dutch families are frequently large; but, on the other hand, when boys are 12 or 13 years old they are sent, if possible, to a farmer, and sleep in the stables or cowsheds, or, more rarely, as at Wilhelminadorp, in the bailiff's

house. Attached to the cottages is a garden of about one-eighth of an acre in extent, and a piece of potato-land of about one-fourth of an acre is let to them at a low rate.

The day labourers live chiefly on potatoes and bread. They prefer white bread, for which they pay about $3\frac{1}{4}d.$ per lb. They feed their own pigs and eat the produce, and they also buy American bacon, which is very cheap. They drink weak coffee and a little gin.

In estimating the condition of the labourer on this farm, it should be remembered that while he is paid only for the time he is actually at work, and not when stopped by rain or other causes, yet on the other hand, although Mr. van den Bosch has a steam threshing-machine, he threshes a great deal with the flail in order to give work to the people, although the work is not so well done (except in the case of beans), and is more expensive.

As to whether the labourer has improved either in mind, body, or estate, Mr. van den Bosch informs me "that they are in a better condition than in former years. They have higher wages, whilst prices of food are moderate, and some articles, as bacon and ham, have been rendered much cheaper by the large importations from America. There is not much change as to their habitation and allotment of land. It cannot be stated that the younger generation has improved as to habits of sobriety, respect for superiors, &c.; whilst some are not satisfied with their position in life, and try to change it."

Farm Buildings.—There are six farmsteadings, which are practically large rectangular barns, with horse-stalls on one side and cattle-stalls on the other. The remainder of the space is designed for the storing and threshing of the bulk of the crop. Outside, adjoining the cattle-stalls, are some open yards with covered sheds for the younger cattle, and on the barn side is a road made of bricks, and then a series of stacks so that the steam threshing-machine may be equally conveniently placed to thresh the corn in the barn and that in the stacks. The sheep-sheds are span-roofed and thatched with straw, being furnished with a yard for each division, which contains either six breeding animals or 20 fatting sheep.

General.—Before leaving the Wilhelmina Polder, I should like to point out the manner in which advantage has been taken to drain the land by our English system of pipes instead of the Dutch system of open ditches. This has enabled Mr. van den Bosch to use steam-cultivating machinery and to effect a large economy of horse-power, although the major portion of the crops is cut by reaping-machines. The usual calculation in the polder district is 1 horse to 7 hectares ($17\frac{1}{2}$ acres), and I have

found the proportion as high as 1 horse to 5 hectares ($12\frac{1}{2}$ acres). Now, although from 10 to 12 horses are bred annually from the working staff, that staff numbers only 108 for 1450 hectares, of which 1200 are under the plough. Even with an allowance of 1 horse to 10 hectares, there is an economy of a dozen horses in addition to the loss of power arising from the breeding of a dozen foals annually, and this must be put to the credit of the steam plough, only two examples of which I have seen in the Netherlands, although I believe that there is a third.

Another peculiarity which this farm shares with some others in the polder districts is the growth of crops having a high market value. Madder has been displaced by coal-tar dyes, but carraway seed is grown in its stead. Blue peas, flax, maize, and other crops are also grown, as a market can be found for them, or as they are found to be useful on the farm; while the growth of rape-seed (colza) was promptly abandoned when the use of paraffin and other mineral oils reduced the price of colza-oil to an unremunerative level.

VII.—*On Permanent and Temporary Meadows and Pastures, and their Functions in the Economy of Agricultural Practice.* By Monsieur H. Joulie.

[Extracts from a Paper read at a Meeting of the Société des Agriculteurs de France, Feb. 23, 1881, and awarded a Gold Medal by that Society. Translated by William Smith, Esq., Pen Park, Filton, Gloucestershire.]

Deterioration of Permanent Grass-land.—Generally speaking, the products obtained from permanent meadows or pastures do not continue uniform, neither are they constant in quantity or quality. The yields, which are at first high, if the grass-land has been laid down under suitable conditions, soon fall off and take a normal level of production, which is maintained for a certain number of years, longer or shorter according to the nature of the soil, the care bestowed upon it, and the manures or dressings which the land receives. After this, deterioration more or less rapid, results from the progressive invasion of *bad kinds of grasses*, which gradually alter the quality of the grass or hay so as to render it innutritious, and lastly the yield falls below the limit at which it is remunerative.

It is easy to explain the cause of this deterioration. At first the grass-plants find a soil suitably dressed with farmyard or other manure, that is to say, containing all the elements necessary for their growth. So they grow vigorously. But little by little the soil becomes more compact, the subsoil more

dense, and the rain or water of irrigation penetrates with greater difficulty. During the droughts of summer, the moisture rises up less easily from the subsoil; and thus, from physical causes, the production settles down to a normal level. In time, the chemical condition of the land also undergoes a material change; not only is the layer of soil which is occupied by the roots rendered incapable of supplying a sufficiently large amount of the elements necessary to the vegetation, but, owing to the continued accumulation of vegetable *débris*, the layer of soil in which the roots live at length becomes sour, even where the earth may originally have been calcareous, and may still be so in the underlying layers, so that the good plants tend to disappear, and give place to a vegetation which is characteristic of sour land. Moreover, the essential elements, which the soil originally contained in sufficient quantities, gradually become exhausted; first by the removal of the crops, and secondly from the superabundance of organic matters, by means of which the potash, phosphates, and carbonate of lime are rendered much more soluble, and are consequently more easily carried down into the subsoil, where the roots cannot reach them.

With the exception of the variations due to farmyard or chemical manures which may have been recently applied, it is practically established by the analyses of the subsoils of grass-lands that they are usually richer in phosphoric acid, potash, lime, and magnesia, than the upper soil, which is usually much richer in nitrogen. This descent in the soil of mineral substances by means of organic solvents is rendered very evident by the percentage of nitrogen in the subsoil, which though in general less than on the surface, yet is often found to exceed that of good arable soils.

Here are some examples taken in cases where analyses of the subsoils were made :—

No. of the Analysis in General Table of Soils.	Nitrogen in Upper Layer, 7·874 in. deep (= 20 centimetres).		Nitrogen in Under Layer, 7·874 in. deep (= 20 centimetres).	
	In 100 parts.	In 1 Acre.	In 100 parts.	In 1 Acre.
10	·275	4·38 tons	·075	1·19 tons
16	·529	8·42 ,,	·511	8·13 ,,
18	·525	8·36 ,,	·362	5·76 ,,
35	·246	3·91 ,,	·162	2·58 ,,
25	·379	6·03 ,,	·123	1·95 ,,

Advantages of laying down Land to Grass for short terms.—Artificial grasses which we intercalate in the rotation of crops, on arable lands, have the advantage of being sown on a soil which is frequently aërated by tillage, and on which they are not left sufficiently long for those causes of deterioration to be exerted, which we have just indicated in the case of permanent grass-lands. Much larger yields are therefore obtained from them.

Grass-lands laid down on the plan recommended by M. Goetz are simply grasses sown on soils deeply ploughed and suitably manured, and are at any rate, at first, in the same condition as temporary grass-lands.

This is why very high returns are obtained from them for the first two or three years. But if it is intended to maintain them and so transform them into permanent pasture, all the causes of deterioration which I have pointed out are gradually developed, and the yield soon sinks, do what we may, to a level, variable according to circumstances, from which it will be impossible to raise it again without breaking up the soil afresh. Hence the failures which the Goetz method has entailed on farmers who have sought to make it the basis of their system of farming.

Of all the various methods for producing hay, the best, without doubt, is that of temporary leys, composed either of graminaceæ alone, or of a mixture of graminaceæ and leguminosæ, according to the nature of the soil. Are not fields of leguminosæ, such as clovers, sainfoin, lucerne, which are of such service in well-directed farming, simply temporary grass-lands? The merits which have so long been recognised in them, belong equally to temporary occupation by graminaceæ, and these have, moreover, the advantage of being serviceable as pasture, which is only seldom the case with fields of artificial leguminous grasses.

Comparison between Hay-growing and Depasturing.—For the purpose of determining accurately the practical advantage of depasturing, I made, in conjunction with M. Vilmorin, an experiment, of which the results were as follows:—

Two pieces of land of the same extent were ploughed up and sown with a mixture of graminaceæ and leguminosæ in 1879. In 1880, the grasses being well established, we mowed one of the pieces, as soon as the greater number of the species on it were in flower. We obtained our first cut on June 9th, 1880. The surface of the piece was 18·42 yards square. The weight of the crop green was 96·53 lbs. avoirdupois. After turning and drying in the air, the weight was reduced to 38·61 lbs., and when completely dried, at 100° C., the total weight of hay

was 32·75 lbs. avoirdupois. On August 9th of the same year, we were able to make a second cut, which gave the following results :—

		lbs. Avoir.
Weight of the aftermath, green	.. ..	48·92
,, ,, turned and dried in the air	.. ..	17·12
,, ,, completely dried at 100° C.	.. ..	14·11

At the end of the season we made a third mowing, which consisted of the leguminosæ, as the graminaceæ had not grown high enough to be reached by the scythe. As, moreover, the second piece of land of which I am about to speak did not at that time give a corresponding crop, we have taken no account of this last mowing.

The crops obtained from the first piece calculated per acre gave the following results :—

	1st Mowing.	2nd Mowing.	Total.
Mixed Hay—green	11·32 tons	5·74 tons	17·06 tons
,, —turned	4·53 ,,	2·00 ,,	6·53 ,,
,, —dried at 100° C.	3·84 ,,	1·65 ,,	5·49 ,,

On the second piece of land, which was prepared in every way like the first, in order to imitate the effect of depasturing as much as possible, we made six successive mowings on April 17, May 8, May 24, June 16, July 10, and August 9; after this last cut, a small aftermath again grew up, which the animals could graze, but which it was very difficult to mow. This is the reason why we did not mow the last aftermath of the first piece.

The six mowings gave the following results per acre :—

	1st Cut.	2nd Cut.	3rd Cut.	4th Cut.	5th Cut.	6th Cut.	Total.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Hay—green	12·48	2·06	1·99	1·31	2·32	1·10	21·26
,, —turned	2·24	·403	·348	·263	·523	·300	4·079
,, —dried at 100° C.	1·96	·365	·319	·250	·461	·247	3·602

But it is not enough, in order to get a clear idea of the comparative value of the two systems of mowing or depasturing, simply to compare the weights of the vegetable matter obtained.

We must also examine the quality. For this purpose samples were taken with care from the produce of each of the mowings and submitted to analysis.

Here are the results obtained:—

IN 1000 PARTS OF DRY HAY.

		Nitrogen.	Ash.	P_2O_5.	So_3.	Lime.	Magnesia.	Potash.	Soda.	Fe_2O_3.	Silica.
First piece	1st cut	17·62	92·32	6·49	4·14	16·89	3·12	21·62	0·00	1·67	29·67
	2nd cut	21·04	95·76	7·06	2·76	17·10	4·18	25·11	4·73	2·04	27·97
Second piece	1st cut	27·30	109·78	9·99	3·91	13·25	3·89	34·38	0·01	1·24	32·61
	2nd cut	28·44	131·03	12·46	5·71	15·93	4·37	40·39	3·74	0·83	36·51
	3rd cut	36·96	128·52	14·07	6·43	20·43	6·08	37·38	2·29	1·22	21·42
	4th cut	30·14	130·68	14·31	6·91	15·58	5·57	36·34	3·62	1·65	33·76
	5th cut	29·30	115·22	12·35	6·52	16·13	5·63	32·49	2·75	0·83	34·77
	6th cut	34·70	139·88	11·54	5·34	17·69	5·84	28·02	6·74	1·23	50·58

From these data the quantities of the essential elements contained in the various mowings are calculated, and the following results are arrived at per acre:—

FIRST PIECE.

	Crop dried at 100° C.	Nitrogen.	Phosphoric Acid.	Lime.	Magnesia.	Potash.
	Tons.	lbs.	lbs.	lbs.	lbs.	lbs.
1st cut	3·84	151·64	56·19	145·39	26·76	186·42
2nd cut	1·73	77·60	25·86	63·33	15·19	92·76
Totals	5·57	229·24	82·05	208·72	41·95	279·18

SECOND PIECE.

1st cut	1·96	120·42	43·70	57·98	16·94	151·64
2nd cut	·36	23·19	9·81	13·38	3·56	33·00
3rd cut	·32	26·76	9·81	14·27	4·46	26·76
4th cut	·25	16·94	8·02	8·92	3·56	20·51
5th cut	·46	30·32	12·48	16·94	5·35	33·89
6th cut	·24	18·73	6·24	9·81	3·56	15·16
Totals	3·59	236·36	90·06	121·30	37·43	280·96
Differences ..	−1·98	+7·12	+8·01	−87·42	−4·49	+1·78

We see then that, from the second piece, deficiency in weight is made up for by superior quality. It contained 7·12 lbs. of nitrogen, 8·01 lbs. of phosphoric acid, and 1·78 lbs. of potash

more than the first crop. It is lower in percentage of lime and magnesia, which, however, are but of secondary importance, looked at from the cattle-feeding point of view. It is certain then that cattle grazed on the crop of the second piece would have been better nourished than those to which the hay from the first piece would have been given, for they would have had in less weight of fodder at least an equal quantity of nutritive elements. I say *at least an equal quantity*, as the action of the scythe only imperfectly imitates grazing, for it leaves the smoothly cut stalks open and bleeding, and is more prejudicial to the regrowth of the plant than the action of the animal's teeth, which crushes them. Depasturing also leaves on the soil the excrement of the cattle, which constitutes a manure of great strength, and which was not supplied in our experiment. If the grass-land had been grazed, instead of mown six times, it would have supplied the beasts with a larger quantity of fodder than the scythe could get from it.

Depasturing, then, has the advantage over mowing by supplying animals with a much richer and more nourishing food than hay. Young shoots are much more nitrogenous than plants in flower, and young green plants are more digestible than dried ones. In these latter, a great part of the cellulose, which has become woody, is useless, for it traverses the digestive organs of the animal without undergoing that transformation into sugar, which is indispensable for its utilisation as a respiratory aliment. Young plants, on the contrary, besides being richer in nitrogenous matters, sugar, and starch, which are easily digested, contain only recently formed cellulose, but little encrusted with woody fibre, and in a fit state to be transformed into sugar, under the influence of the digestive ferments. This is why depasturing puts more weight on a beast, other things being equal, than can be done by feeding in a shed the hay grown on the same ground. But it presents another advantage, inasmuch as it leaves on the field a powerful manure, which restores to the soil the useful elements of nourishment which the animal has not assimilated: and which, if produced in the shed, can only be returned to the soil deteriorated, and attended with the expense of manual labour and transport.

Aftermaths.—We see, by what has preceded, that aftermaths are richer in nitrogen than first cuts, and that they are more nitrogenous the younger they are gathered; they are richer also in phosphoric acid and potash. Theoretically, aftermaths constitute a better food than first cuts, and yet aftermaths always sell at a lower price than the fodder from first cuts. This is doubtless because their appearance is less pleasing, and possibly also because when dried they may be more

indigestible. There is then a great advantage in feeding them green, or putting them *en ensilage* with green maize, as has been done for some years past by several eminent farmers, among others M. Lecouteux. The nutritive qualities of the maize are thereby considerably increased, and together they form a more complete and better-balanced cattle-food than maize-plants alone.

Practical Conclusions.—We are thus led to practical conclusions of great interest, for, in the present condition of agriculture, the increased production of meat seems to be for a large number of localities the best resource.

Let us now see what teaching results from the preceding facts, in so far as it relates to—

1st. The formation of permanent or temporary grass-lands.

2nd. The keeping up of the same.

3rd. The improvement or the regeneration of old grass-lands.

4th. The treatment of the soil of grass-lands which are worn out.

Much has been written on these points, and I do not wish to revert to what has been said by my predecessors. But the most important point has always escaped them, because the necessary analyses were not made, and this is the side of the question which I now particularly wish to bring forward.

I shall suppose that the necessary physical conditions of the soil, such as tilth, the rendering sweet by drainage, the arrangement of trenches for irrigation if necessary, &c., have been attended to, so as to limit myself to the chemical conditions of the operation. An examination of these conditions is indispensable, for if they are secured, subsequent expenses will answer their purpose, but if not, they will be wasted.

The principles which govern the formation of grass-land are the same, whether for permanent or temporary occupation, but all soils are not equally well suited to produce grass.

To obtain the largest crops, the soil ought to be of a light character, that is to say, as little clayey and as calcareous as possible. But on all soils it is possible to make productive grass-fields, of a more or less permanent character, provided that the soil bed be at least from 4 to 6 inches deep, and the subsoil not impermeable to water.

From a chemical point of view, the soil should be rich in phosphoric acid, potash, and lime; and it is important, if we have to do with permanent grass-land, to be informed at the outset, by analysis, as to the state of the soil. We should be guided by the results of this analysis. If the soil is rich, we should

limit ourselves to furnishing by manures, slightly soluble, and therefore cheap, the quantities of those elements which are necessary to the crop. If it is poor in one or several of the elements, we should begin by giving a dressing of each element in a somewhat soluble form, and should moreover restore to it year by year, by means of soluble manures, the elements taken away by the removal of the crops.

Phosphoric Acid is offered to farmers in three forms, viz. fossil phosphates, precipitated phosphate, and superphosphates. Fossil phosphates contain phosphoric acid combined with lime, are cheap, and very suitable for restoring this indispensable element to rich soils, or for establishing a stock of it in poor soils. When the soil is sour, they partially neutralise this quality and become soluble; but it ought never to be laid down to grass until the sourness has been completely neutralised.

In ordinary soils the phosphates of lime become soluble slowly, under the influence of carbonic acid, organic matters, &c., with which they come in contact. But this slow transformation is sufficient to supply the quantity of phosphoric acid necessary to the actual crop when the soil is fairly rich in it. For every soil, which on analysis shows only 0·05 per cent. of phosphoric acid, or 15·9 cwt. to the acre in a layer of 7·874 inches deep, it is advisable to plough-in a certain amount of fossil-phosphate, before attempting to form permanent grass-land; it is an opportunity not to be lost for distributing this fertilising agent at various depths in the soil. The most suitable phosphates to use are those which contain from 30 per cent. to 50 per cent. of tricalcic phosphate, say from 14 per cent. to 23 per cent. of phosphoric acid. From 16 cwt. to 2 tons per acre should be applied, according to the richness of the soil, as shown by analysis, and the quality of the phosphate employed; so that the soil may be provided with from 267 to 892 lbs. of phosphoric acid to the acre, as may be considered necessary.

This phosphate should be applied in the finest possible powder, and sown broadcast on the soil before the ploughing which precedes the sowing of the seed. If the grass-land is to be sown with a cereal, the phosphate should be applied before sowing the corn. The expense in phosphate should be charged to the cost of the formation of the grass-land, to be liquidated during the number of years it lasts. It would be incorrect to charge it entirely to the first crop, since it acts as a provision for future crops also.

On soils which contain more than 0·05 per cent. of phosphoric acid, it will be sufficient to give in an assimilable form 89 lbs. to the acre, that is to say, enough to supply the first, and even

materially to assist a second crop. The most convenient form to use for this purpose is "precipitated phosphate."

On calcareous soils, and on those which have been dressed with marl, superphosphate may be used; but where lime is deficient, this acid manure favours the development of certain plants, which it is desirable to avoid. By the use of "precipitated phosphate" this inconvenience is rendered improbable.

To soils which reach or exceed ·1 per cent. of phosphoric acid, it will be unnecessary to add any.

Lime.—If on analysis the soil does not show at least 5 per cent. of lime, it is absolutely necessary to give it a calcareous dressing before laying down to grass. This may be done either with marl or lime. Marl breaks up slowly, and its mixture with arable soil only takes place, little by little, under the influence of repeated ploughings, so that it is not suitable in the special case before us, as the soil will not be ploughed up again. Lime is infinitely to be preferred, since it readily breaks up and has moreover a much more powerful action on organic matter than marl, due to the causticity which it retains sufficiently long to allow it to effect some useful reactions.

The quantity applied should vary from 16 cwt. to 2 tons per acre, according to the more or less pronounced poorness of the soil in lime as ascertained by the analysis.

For this purpose the dust of kilns, or limes of inferior quality, which are cheaper than that used for building purposes, may be used.

The lime must be spread broadcast on the field some days before ploughing in. It soon disintegrates and falls to powder under the influence of atmospheric moisture or rain. When this has taken place, it can be ploughed in.

Fossil phosphate and lime may be ploughed in at the same time.

Farmyard-manure.—If there is a supply of farmyard-manure, it is well to give the land a dressing of 21 to 26 cubic yards per acre before laying it down to grass. This manure will nourish the grain-crop which generally precedes the sowing down of the grass-land, and will afterwards supply a stock of useful elements, the benefit of which will be felt for years. If the soil is heavy, it will moreover exert a very advantageous physical effect in lightening the soil. If no farmyard-manure is available, it would be desirable to add, to the manures and dressings which I have mentioned, some artificial manures to provide for the requirements of the first crops.

Potash.—If the analysis shows a smaller proportion of potash in the soil than ·25 per cent., it is necessary at the outset, and

subsequently each year, to give in the form of additional manure the actual quantity of potash required by the crop. This will vary from 89 to 223 lbs. per acre per annum, as the productive power of the soil, resulting from its other physical and chemical conditions, may be equal to a yield of from 1·59 to 4·38 tons of dry hay per acre. As it may not be known what the production will be, I should advise at first a dose of 134 lbs. of potash per acre. If this is insufficient, the following year we must be guided by the amount of crop obtained. On soils where the richness exceeds ·2 per cent., the quantity of potash may be lessened, but unless the percentage is very high, say from ·3 per cent. to ·4 per cent., it is always well to give at least 89 lbs. to the acre, before sowing down the grass-land.

Magnesia.—Soils deficient in magnesia are rare: still some do exist, and when analysis shows that the quantity of magnesia is less than from ·2 per cent. to ·3 per cent., it is necessary that some should be added to the manure. It has been seen that 10 tons of dry hay contain 61·82 lbs. of magnesia on an average. So that it will be well on such soils to add 26·76 lbs. per acre to the manure.

Nitrogen.—I have previously demonstrated that the growth of grass enriches the soil in nitrogenous matters, and that this accumulation of nitrogen in the soil is often considerable. Should we then conclude that nitrogenous manures are useless on pasture-lands, or that it is possible to economise in the application of this element, which is the most costly of all those which enter into the composition of chemical manures?

We have seen also that hay contains more nitrogen than the majority of other crops. It would therefore seem reasonable to infer that some of this nitrogen comes from the atmosphere, even in face of the theory, held by the majority of scientific men and agriculturists, that the soil is the only source from which vegetation gets its food. The latter opinion is hardly tenable any longer, in face of the facts which I have established; but yet, on the other hand, experience shows that nitrogenous manures,—especially nitrates and salts of ammonia,—exercise a very favourable action on the growth of graminaceæ on grass-lands. In the very elaborate work of Messrs. Lawes and Gilbert, recently published in the 'Journal' of the Royal Agricultural Society, I find some valuable information on this point. I have taken from it the following figures, which are an average of agricultural experiments carried on for over 20 years, and carried out with the care, the competence, and the skill, of which these agricultural *savants* have given so many proofs.

	Dry Hay.	
	Yield per Acre.	Surplus due to Manure.
Land without any manure	1·062 tons	
With mineral manures (potash, phosphoric acid, and magnesia, renewed annually)	1·765 ,,	·703 tons
With nitrogenous manure alone:		
1. Salts of ammonia	1·314 ,,	·252 ,,
2. Nitrate of soda	1·769 ,,	·707 ,,
With nitrogenous and mineral manures:		
1. Mineral manures and salts of ammonia ..	2·545 ,,	1·480 ,,
2. Mineral manures and nitrate of soda ..	2·857 ,,	1·795 ,,

If it is true that mineral manures are alone sufficient to give an extra annual return of ·703 tons per acre on the first mowing (this being the only mowing of which an account was taken, the aftermaths having been depastured), it is no less true that nitrogenous manures, added to the mineral manures, have raised this surplus to 1·483 tons per acre in the case of the salts of ammonia, and to 1·795 tons per acre in the case of nitrate of soda. To these facts, carefully verified, the experience of farmers must be added, for they use on certain grass-lands manures almost exclusively nitrogenous, such as dried blood, sulphate of ammonia, nitrate of soda, &c.

I am warranted in stating that these manures would not produce such effects if the soil was not also abundantly furnished with the necessary mineral elements, and that the employment of nitrogenous manures alone, tends to the rapid exhaustion of those elements, which are not returned to the soil. But it is certain that if the nitrogenous manures did not produce an increase in the crop, at least to the extent of their value, farmers would long ago have ceased to use them. It is therefore certain that nitrogenous manures do exercise a favourable influence on the development of grasses, when the mineral elements indispensable to them are not wanting. Is it necessary then to supply to grass-lands, in addition to the dressings of mineral manures mentioned above, the whole of the nitrogen necessary to the crop? If this were so, the cultivation of grass-lands would become unprofitable.

We have seen that 10 tons of dry hay contain 384·38 lbs. of nitrogen. In a soluble condition, this element, according to current prices and distance from the manufactory, costs from 10¾*d.* to 1*s.* 1*d.* per lb. delivered, say an average of 1*s.* If then we had to supply to the soil all the nitrogen required, we

should have to spend on this element alone about 16*l.* 4*s.* 4½*d.*, if to this we add the cost of the other necessary elements, viz.—

			£	s.	d.
		d.			
Phosphoric acid	at	4·355 per lb.	2	17	10½
Lime	„	·130 „	0	3	6
Magnesia	„	3·048 „	0	15	4½
Potash	„	2·177 „	4	15	11
Nitrogen		.. ..	16	4	4½
			£24	17	0½

we should arrive at an excessive cost; for the value of 10 tons of dry hay in the market is not above 32*l.* 10*s.* 5*d.*, and this would only leave 7*l.* 13*s.* 4½*d.* to pay for the rent of land, manual labour, and carriage to the market, which is clearly insufficient; especially when we take into account that it usually takes 5 acres, at least, to produce this quantity of hay.

The problem of the production of hay presents then a double contradiction:

1st. Its production requires *assimilable* nitrogen in the soil, since manures with *assimilable* nitrogen undoubtedly influence it to a large extent. It uses up nitrogen borrowed from the soil, and therefore would be expected to exhaust it, whereas the analyses of soils previously given unmistakably show that grass-growing, so far from exhausting the soil of nitrogen, on the contrary greatly enriches it.

2nd. Practically, grass-lands are let at a higher rent than other lands, and supply crops, which, eaten in the sheds, give a manure which is used for arable lands, so that not only does grass-growing enrich the soil on which the meadow is laid down, but it also supplies nitrogen to the root- and grain-crops, which contribute to the richness of the farm.

I have just shown that if it is necessary to make a complete restitution to the soil of all the elements removed, then the cultivation of grass-lands would be too expensive. How then can the action which assimilable nitrogenous manure has on the growth of grass be explained? Like the greater number of cultivated plants, meadow-grasses derive from the atmosphere the greater part of the nitrogen which is found in their tissues, but they only absorb it by means of their leaves, when these are sufficiently developed. It must then be at the beginning of the season, when vegetation takes a fresh start, that the plants should find in the soil and be able to absorb by their roots a small quantity of highly assimilable nitrogenous matter, so as to enable them to form their first leaves, by means of which they will subsequently nourish themselves at the expense of the

atmosphere. Such, in my opinion, is the explanation, which results from all that we know about vegetation; and it removes the contradictions which have so barred the minds of those who are unwilling to admit the intervention of atmospheric nitrogen in the nourishment of plants. By this explanation, which is simple and yet well founded, all becomes clear, and the problem of the economical production of crops in general, and of hay in particular, is solved.

Practically, it will be sufficient to give to the soil, under favourable conditions, in the form of an assimilable manure, the small amount of nitrogen necessary for the plant to make its first growth; and the crop will give back to the earth and to the farmer more than ten times the amount of nitrogen so supplied to it.

On strong soils which quickly fix nitrogenous salts, and hold them with energy, I advise a dose of 267 lbs. to the acre as a top-dressing after the last ploughing. On light soils where the salts sink quickly, I think it would be imprudent to exceed 89 lbs. to the acre, for it would only be to expose oneself to loss. But it will be useful to give a second dose of 89 lbs. about the middle of the season. Experience will teach every one the limit, at which he must stop if the conditions of growth from time to time are carefully noted.

Even where farmyard-manure has been ploughed-in in large quantities, before laying down to grass, it will nevertheless be useful to add nitrogenous salts as a top-dressing after the last ploughing, for the purpose of promoting the early development of the plant as above explained.

Finally.—Laying-down to grass requires, that, whilst taking account of the chemical composition of the soil as shown by analysis, there should be—

1st. A provision of fossil-phosphates and lime as a bottom-dressing of manure, if the soil is not sufficiently rich in lime and phosphoric acid. This expense should be spread over the duration of the ley;

2nd. From 21·168 to 26·48 cubic yards of farmyard-manure per acre, to furnish the phosphoric acid, potash, and nitrogen necessary for the first crops, an outlay to be spread over the first 3 or 4 years: or if no farmyard-manure is obtainable, it must be replaced by a dressing of chemical manure applied after the last ploughing and containing per acre

Assimilable phosphoric acid	44·60 lbs.
Potash	133·80 lbs.
Nitric Nitrogen	from 13·38 to 40·14 lbs.

The cost of this varies from about 53*s.* 5*d.* to 81*s.* 3*d.* per

acre, according to the amount of nitrogen employed, and should be charged to the crops of the first or two first years, according as the grass-ley may have been sown by itself or with a grain-crop.

3rd, and lastly. Although farmyard-manure may have been employed, yet it will still be desirable to give a dressing of 89 lbs. of nitrogenous salts to the acre.

Choice of Seeds.—The chemical composition of the soil having been determined by analysis, it will be easy to choose plants whose wants are most suitable to the nature of the soil.

Let us suppose that the soil to be dealt with is poor in potash, we shall be able to select those which require the least amount of potash and mix them so as to form our ley.

Here are two mixtures in which the requirements of potash and phosphoric acid greatly differ :

First Mixture.

	In 10 Tons.			
	Phosphoric Acid.		Potash.	
		In 1000 lbs.		In 1000 lbs.
Rye-grass (Lolium perenne) ..	151·2 lbs.	6·750	813·1 lbs.	36·300
Phalaris bleuâtre	127·2 ,,	5·680	703·3 ,,	31·400
Avena flavescens	133·9 ,,	5·980	594·7 ,,	26·550
Anthoxanthum odoratum	153·4 ,,	6·850	579·9 ,,	25·890
Festuca pratensis	123·6 ,,	5·520	488·9 ,,	21·830
Schrader's Bromegrass	180·7 ,,	8·070	482·7 ,,	21·550
Mean	145·0 lbs.	6·375	610·4 lbs.	27·256

Second Mixture.

Poa nemoralis	92·2 lbs.	4·120	243·0 lbs.	10·850
Bromus pratensis	81·0 ,,	3·620	304·4 ,,	13·590
Poa pratensis	99·2 ,,	4·430	341·3 ,,	15·240
Cynosurus cristatus	83·3 ,,	3·720	341·3 ,,	15·240
Festuca rubra	74·8 ,,	3·340	366·6 ,,	16·370
Phleum pratense	92·5 ,,	4·130	372·0 ,,	16·610
Mean	87·1 lbs.	3·893	328·1 lbs.	14·650

The second mixture, which is only about half as exhaustive to the soil as the first, in producing the same amount of hay, would succeed on much poorer soils than the first. This idea struck M. Goetz, who, without being able to explain the reasons to himself, yet succeeded by a long method, and one difficult of application, in getting from each soil information

which can be obtained far more surely by the chemical analysis of the soils which are to be laid down to grass.

M. Goetz sowed separately the various kinds of seeds, and afterwards he mixed those seeds which succeeded best on the soil to be laid down to grass. Now, those seeds which succeed best are always those whose wants are best supplied by the elements which the soil places at their disposal.

We could then, now that the requirements of the various grasses are accurately known, gather from the "trial" meadow-plan of M. Goetz a fairly accurate idea of the chemical composition of the soil on which it is proposed to operate. But why occupy ourselves with forming a meadow of plants most suited to the composition of the soil, when we can by means of manures modify the composition of the soil itself in any way we wish?

The choice of plants ought chiefly to be determined by the *physical properties* of the soil? If it is moist, we should employ those plants which least fear moisture; if it is dry, those which are best suited to withstand drought. Of those which conform best to these two conditions we should prefer those which give the best fodder, and those which flower nearly about the same time, especially if the grass-lands are to be mown. For grazing land the last point is of less importance, but we should avoid those plants which cannot resist the treading of the cattle. The mixture being adjusted in accordance with the principles laid down, taking care also to add a due proportion of leguminosæ to the graminaceæ, we can calculate the average requirements, by consulting the figures given in the preceding tables. We must conduct our system of manuring in such a manner as to satisfy the requirements of growth, taking also into account the original chemical composition of the soil.

We shall learn further on, how more particularly to encourage certain kinds of grass and impede the growth of certain others, so as to maintain the grasses best suited for the production of hay of good sound quality.

Maintenance of Grass-lands. — Permanent and temporary grass-lands must alike be properly nourished if we do not want to see them rapidly fall off in their returns. The mode of maintaining them must be varied as they are to be mown or grazed.

For grass-lands which are to be mown, the treatment will consist essentially in the annual restitution of the mineral elements carried off by the crops, and with which the soil is not superabundantly supplied. This restitution of the whole of the mineral elements supplied by the soil to the crop carried off it should be complete. The most suitable manure to effect

this restitution will be a mixture of salts which contain these elements in the most convenient form.

Since there is in one ton of dry hay on an average—

	lbs.	Or in 1000 lbs.
Phosphoric acid	16·14	7·12
Potash	52·88	23·61
Magnesia	6·18	2·76
Lime	32·61	14·56

it will be well in the majority of cases to dress the soil with a manure of similar composition. It is easy to combine a manure containing in every 100 parts—

Assimilable phosphoric acid	5·0
Non-assimilable do. do.	1·5
Potash	14·0
Lime	20·0
Magnesia	2·0

at the rate of 5*s.* 7¾*d.* per cwt., including sacks, or say 6*s.* 1*d.* per cwt. delivered at the farm, making an allowance of an average freight of 5*d.* per cwt.

336 lbs. of this manure compensates, more or less exactly, for the loss sustained by the soil in producing 1 ton of hay. Supposing that an entire restitution of the mineral elements is necessary, an expense of 18*s.* 3*d.* per ton of hay produced will be incurred.

But we have seen that it is useful to add a little nitrogen to the manure for grass-land. If we use nitrate of soda we may fix the beneficial amount at 138·8 lbs. per acre, supplying 20·51 lbs. of nitrogen; say about 6·72 lbs. of nitrogen, or about 44·8 lbs. of nitrate of soda, per ton of hay produced.

We could introduce this quantity of nitrate of soda into the manure, by reducing the proportion of lime, which is really in excess of the actual requirements. We should thus get a manure containing—

	In 100 parts.	In 336 lbs.
Assimilable phosphoric acid ..	5·00	16·80
Non-assimilable do. do. ..	1·50	5·04
Potash	14·00	47·37
Magnesia	2·00	7·05
Nitrogen assimilable	2·00	7·05
Lime	15·00	50·40

This manure is worth 8*s.* 1½*d.* per cwt., packed in bags, or say about 8*s.* 6½*d.* per cwt. delivered at the farm. The amount of 336 lbs. being necessary to produce one ton of hay, would

involve an expense of 26*s.* 11½*d.* If we allow for the hay the value of 65*s.* 0½*d.* per ton, there remains a margin of 39*s.* 5*d.* to cover the expense of labour, rent of land, general expenses, &c. With a crop of hay of 2·787 tons per acre, there is a difference of 109*s.* 10*d.* between the cost of the manure and the value of the crop, a difference which should yield an acceptable profit. But, in the case of temporary grass-lands, laid down as I have pointed out, it is not unusual to obtain from 3·98, 4·33, and even 5·97 tons to the acre: in such cases the profit is considerable; and hay-growing appears to be one of the most lucrative operations to which we can turn our attention. I hasten to add that it is not always necessary to use so expensive a manure: in the majority of cases the nitrogen may be dispensed with, as either the soil is sufficiently supplied with it already, or because the process of nitrification in it is sufficiently active to set at liberty the quantity of nitrogen annually required.

The best means to get information on this point is to make trials with the two manures we have just mentioned. If the nitrogenous manure does not produce a greater effect than the other, it is evident that it is possible to save the nitrogen, and to add about 16*s.* 2*d.* per acre to the profit. On soils whose analysis shows the presence of more than ·25 per cent. of potash, a saving could also be made in direct ratio to the richness of the soil in potash.

For guidance in this matter we need only examine the plants on the land. If the leguminous plants on it are well developed, and tend to supersede the graminaceæ, we should diminish the dose of potash and increase the nitrogen. If, on the contrary, the graminaceæ stifle the leguminosæ, it is better to reduce the dose of nitrogen and increase that of potash. By this mode of proceeding it is always possible to maintain the growth of grasses in the most favourable condition, both as regards quantity and quality.

It is, moreover, always well to dress the soil of temporary and permanent grass-lands with a certain amount of lime, say about 7·96 cwt. per acre annually, to prevent sourness, to favour the decomposition of the organic *débris*, and to render assimilable a certain amount of the nitrogen it contains. This dressing of lime will not add to the expense of maintenance, for it will always be possible by its means to reduce proportionately the expense of nitrogen or potash, according as the graminaceæ or leguminosæ are most abundant. Lime is useful even for permanent grass-lands on calcareous soils, for it is not rare to find meadows sour on the surface which at 7·874 inches deep are highly calcareous.

P 2

This arises from the accumulation of organic *débris* on the surface of the soil. In the case of temporary grass-lands, the dressing with lime can be dispensed with where the soil contains more than 5 per cent. of lime. And as the ley only lasts two or three years, there is no fear of its getting sour, for the plough effects the mixture of the superficial with the lower layers of the soil.

Lastly, on land which by analysis contains more than ·30 per cent. of magnesia and ·10 per cent. of phosphoric acid, the magnesia may be reduced, or even dispensed with, and the assimilable phosphate of lime in the manure may be replaced by fossil phosphate, which appreciably diminishes the cost.

The dressing of lime should be applied in the autumn, immediately after the last mowing. The chemical manures should be applied in early spring, before vegetation makes its new start.

*Farmyard-manure.**—I cannot conclude this article without alluding to the comparatively small utility of farmyard-manure for maintaining grass-lands. We have seen that grass-lands require but little nitrogen, but that they ought to have it in the most assimilable form, because it must act promptly, especially at the starting of the annual vegetation. To obtain the maximum advantage from this nitrogen, I have said that it ought to be applied in the form of nitrogen salts; now, farmyard-manure contains a large amount of nitrogen, but very little in a soluble state, and none in the nitric state, unless indeed it is in an advanced state of decomposition.

The nitrogenous matters in farmyard-manure only furnish assimilable nitrogen slowly and in small quantities, and the work of transformation only proceeds when the manure is mixed with a soil easily permeable by air and moisture.

The application of farmyard-manure as a top-dressing to grass-lands, is not favourable for the promotion of the necessary chemical transformations. It should be applied in large quantities and in a very advanced state of decomposition, in order to obtain from it an appreciable effect; further, it owes its effect more to the potash and other mineral elements which it contains, than to its nitrogen, which, by this mode of application, is almost wasted.

Moreover, to supply the necessary potash by means of farmyard-manure, which only gives it up very slowly, for every ton of dry hay about 5 tons of well-rotted farmyard-manure are necessary; that is to say, about 13·49 tons per acre for the production of

* M. Joulie's views on the suitability of farmyard-manure as an economical dressing for grass-land do not agree with those of Dr. Voelcker. *Vide* 'Journ. Royal Agric. Soc.' Second Series, vol. xiv. p. 836.—Edit.

2·787 tons of dry hay. The value of farmyard-manure being about 8*s.* 1½*d.* per ton, the expense will be 109*s.* 7¾*d.* per acre, whilst that of the chemical nitrogenous manure, as we have seen, was only 50*s.* 3½*d.* There is therefore a marked advantage in using a chemical manure, by which we can make the various economies which I have pointed out; especially as with farmyard-manure we are unable to alter the percentage of any one of its constituents without reducing the rest at the same time.

If, on the other hand, we compare the composition of 1 ton of hay with that of 5 tons of farmyard-manure, we shall see that the latter contains an excess of several elements which will of necessity remain unemployed:—

	In 1 Ton of Dry Hay.	In 5 Tons of Farmyard-Manure.	In 1 Ton of same.
	lbs.	lbs.	lbs.
Nitrogen	38·43	64·96	12·98
Phosphoric acid ..	15·94	40·32	8·06
Potash	52·86	56·00	11·20
Lime	32·48	109·76	21·95
Magnesia	6·18	20·16	4·03

This calculation is based on the average composition of well-rotted farmyard-manure, taken from the tables of Wolff.

We have seen that it is sufficient to supply 6·72 lbs. of nitric nitrogen to produce 1 ton of hay, while 5 tons of farmyard-manure contain, if my analysis is correct, 58·24 lbs. too much nitrogen; and yet, notwithstanding this excess, farmyard-manure is less efficacious than the manure I advise, because it does not give in the required condition the 6·72 lbs. of nitrogen which are necessary. Moreover, it contains phosphoric acid, lime, and magnesia in great excess. Farmyard-manure, then, is far more suitable for the cultivation of arable than of grass-lands; for in ordinary cultivation, the plough mixes it with the mass of the soil, and the succession of crops allows of the successive utilisation of all the elements it contains. This important conclusion is borne out by practical experience.

Messrs. Lawes and Gilbert, in the experiments to which I have previously had occasion to allude, have maintained a piece of grass-land by applying to it annually for 8 years 13·47 tons of farmyard-manure to the acre. At the end of this time they had to discontinue the use of farmyard-manure, because the mass of organic matter which had accumulated in the soil made them fear that vegetation might thereby suffer. The average return of the first mowing for the 8 years was 4798·9 lbs.

to the acre, whilst the plot without manure gave 2662·6 lbs. to the acre; a difference of 2136·3 lbs., which would not pay for the quantity of farmyard-manure employed. Doubtless, it might be said, that the quantity of farmyard-manure was excessive, and, according to the rule I have laid down, it ought to have been restricted to 9·87 tons per acre, which would be five times the weight of the hay actually produced. But, supposing that with such a reduction the return had been the same, it is still clear that the additional quantity produced would not have paid for the manure, and that it would have been more economical to omit the manure altogether.

Messrs. Lawes and Gilbert continued these experiments for 13 years, without any further addition of farmyard-manure. During the 5 years which followed the omission of the farmyard-manure, the return was maintained at the constant level of an annual average of 4841·7 lbs. to the acre; but in the 7 years which followed, it fell to an average of 2541·3 lbs. The general average over 20 years for this piece of ground, which had received annually during 8 years 13·47 tons of farmyard-manure to the acre, which would be an average of 5·575 tons a year throughout the duration of the experiment, has been 4126·3 lbs. per acre, only exceeding, by 172 lbs., the field which had only received mineral manure, and by 1845·6 lbs. the return of the unmanured field. Thus Messrs. Lawes and Gilbert arrived at the following conclusions:—

"In conclusion, of all the useful elements which farmyard-manure contains, it is the nitrogen which is the least profitable for the cultivation of grass-lands: assimilable with difficulty, it accumulates in the soil, and ends by forming a residue easy to estimate, but of extraordinarily slow action. The result of this is, that the agricultural value of nitrogen is less in farmyard-manure than in soluble manures such as sulphate of ammonia, nitrate of soda, &c."

Certain Organic Manures.—If farmyard-manure, the complete manure, *par excellence*, is not economical for grass-lands, what shall I say of the many manures, indefinitely variable in composition, and daily puffed by those who seek to palm off on agriculture, to their own advantage, the refuse of industries which can be turned to no other account? It is useless to examine in detail these various manures. The requirements of grass-lands having now been pointed out, it will be easy to recognise the value of any manure from its analysis.

Artificially-watered Grass-lands.—As yet I have only referred to grass-land that is watered solely by the rain. This is the case with all temporary, and with a large number of permanent grass-lands. But there are also large extents of grass-land

cultivated artificially by irrigation. For these we must take into account the elements which the water can bring or take away. This determination can only be made if we know the mode of its distribution, the amount of it the land can absorb, and the useful elements contained in it. As these conditions vary considerably, according to situation, it is difficult to say anything except in a general way. It is, however, probable that in many cases it will be found well to give to the land after each mowing a small dressing of manure, of like composition to that which is suitable for the maintenance of unwatered grass-lands. It pays better to apply the manure frequently, and in small quantities only, so as to avoid, as much as possible, the risk of its being washed away. This would apply equally to any sloping meadow not artificially irrigated, and that permits the rain-water to run freely off its surface.

Pasture-lands.—When grass-lands are used for pasture, the greater part of the fertilising elements contained in the grass are returned at once to the soil in the excrements of the cattle. The restitution being thus partially effected on the spot, artificial manures are less necessary. Nevertheless the cattle only return a portion of the mineral elements which have been supplied to them by the grass. The potash, lime, and magnesia are found, for the most part, in their excrements, but the phosphoric acid is carried off by them in relatively greater proportion; hence the advantage of annually restoring to grazing-land the phosphoric acid so removed. It will also be well to apply a certain quantity of potash, being guided in this matter by the plants on the land, and in the way I have previously pointed out. In the great majority of cases the desired end will be attained by applying annually in February 267·6 lbs. to the acre of a mineral manure, containing—

	In 100 parts.	In 267·6 lbs.
		lbs.
Assimilable phosphoric acid ..	12·0	32·11
Non-assimilable do. do. ..	2·0	5·35
Potash	5·0	13·38

This manure should be obtained commercially at 7*s.* 5*d.* per cwt., say, 8*s.* 10*d.* per cwt. delivered; or at an annual expense of 19*s.* 0½*d.* per acre.

As far as regards nitrogen, the animals' dung, &c., provides sufficiently, so that this need not be a point for our consideration.

In the case of grass-lands for mowing, it will always be well, in order to prevent any tendency to sourness, and also to hasten the decomposition of the organic *débris*, to top-dress annually before the winter with 7·96 cwt. of lime to the acre.

In short, the maintenance of good pasturage will be effected by using annually 267·6 lbs. to the acre of the mineral manure

mentioned	= 19*s.* 0½*d.*
7·96 cwt. of lime	= 7*s.* 4½*d.*
Total	= 26*s.* 5*d.*

On many soils it will be possible to reduce this, the maximum expense, by taking account of their richness in the essential elements, as shown by analysis; and I am convinced that farmers who take the course which I suggest will not regret the money so laid out on the soil, for it will make them a good return for the expense incurred.

Restoration of old Meadows and Pasturage.—All that I have said on the maintenance of grass-lands applies equally to the restoration of those which, although in good condition, were not laid down in the manner I have indicated. Unfortunately a large number exist which give but poor yields, and these of bad quality, because they were originally laid down under defective conditions, and because they have subsequently been maintained in an insufficient and ill-advised manner, if, indeed, they have received any care at all. By the analyses of soils given above, we have learned the ordinary chemical composition of the soils of grass-lands. They usually contain plenty of nitrogen, but in an almost unassimilable condition; and usually there is a deficiency of potash and of phosphoric acid.

If we wish to restore grass-land, we ought, first of all, to apply in the autumn 15·92 cwt. of lime per acre, in order to render a sufficient quantity of nitrogen assimilable by the ensuing spring. In February we should apply per acre 7·96 cwt. of the mineral manure, at 6*s.* 1¼*d.* per cwt., the composition of which has been given above. The application of this manure should be followed by a good harrowing, and if the physical condition of the soil is suitable, there will certainly be a very marked improvement. It is well at first to begin on a limited area, for it may happen that the physical conditions of the soil will not permit the chemical agents employed to produce their full effect. If the expenses of liming and manuring are not amply recouped by the improvement in the yield of grass, the idea of renovating the pasture must be abandoned; we must break it up and put the soil under some other

course of cultivation by which results superior to those given by inferior grass-lands will be obtained.

Breaking up inferior Grass-land.—Much has been said both for and against the breaking up of inferior grass-lands. Some recommend it strongly, basing their opinion on the fact that broken up pasture-land will produce large arable crops for several years, and would probably be laid down to grass again in improved physical condition. Others, on the contrary, reject this practice, because, after breaking up the pasture, they consider they get nothing sufficient to recompense them, and they find that the pasture, when again established, after several years of expensive cultivation, is hardly better than that which preceded it.

Both of these contradictory opinions may be true according to the varied composition of the several soils. If the mineral elements are abundant, breaking up the pasture cannot fail to give good results, for it mixes the upper more nitrogenous layer, with the lower one which is richer in mineral matters, subdivides and aerates the soil, and so favours those chemical reactions, by means of which the requisite elements pass from an inert to an assimilable state. But if the land is deficient in one or more of these elements, a state of things by no means rare—for had that not been the case the grass-land would have continued to give good results—the breaking up can only be successful, if the one or more elements which are wanting are supplied in sufficient quantity, and in an assimilable condition. It is then, above all, indispensable to be well informed on this point; and for this end to analyse a judiciously chosen sample of the soil of the grass-land on which it is proposed to operate. According to the results of the analysis, such elements should be employed as will efficiently supply the needs of the growing plants.

I will now give two practical examples.

First Example.—In 1874 I was shown some land from which good crops were unobtainable in spite of careful culture, and an abundant supply of farmyard-manure.

It was a field belonging to a farm at Moissy-Cramayel, near Lieu-Saint (Seine-et-Marne). It was surrounded, at least to all appearances, by fields of the same character of soil, and from which the best results that the most intelligent "intensive" cultivation could aspire to, had been obtained. The only difference between it and the adjoining fields was that it had been under grass from time immemorial, and had been broken up recently because the grass grown on it did not pay the rent of the land.

My first care was to analyse the soil; the analysis gave me the following results:—

COMPOSITION in TONS per ACRE.

	In the Soil.	In the Subsoil.
Nitrogen	6·036	1·799
Phosphoric acid ..	·535	·100
Lime	89·136	8·340
Magnesia	·242	·232
Potash	·057	1·761

Seeing the small percentage of phosphoric acid, I advised the ploughing in of 7·96 cwt. of fossil phosphate to the acre, together with 15·92 cwt. of lime, to render the nitrogen in the soil assimilable. I ordered, subsequently, a top-dressing of 3·17 cwt. of superphosphate, containing 42·81 lbs. of phosphoric acid in an assimilable state; the field was then sown with winter wheat. Up to May 1875 all appeared to be going on well; but at that time the wheat-plant became yellow, and dwindled away, as it had done in previous years. On receiving information of this, I visited the field, and on May 30, 1875, I noticed that the wheat was only 11 to 15 inches high, with 3 or 4 grains in the ear, whilst the neighbouring fields were full in the ear; but I remarked, that in different parts of the field there were tufts of wheat-plants which had succeeded very well. This occurred where the urine of the animals employed in ploughing had fallen. I took a sample of the wheat-plants grown on these spots, and also of the general growth of the field, and submitted them to analysis. Here are the results:—

	Wheat on Good Spots.	Average Wheat of Field.
	Grains.	Grains.
Mean weight of dried stalk ..	27·315	7·253
COMPOSITION PER 1000 PARTS OF DRY SUBSTANCE.		
Organic matter	932·300	925·100
Ash	67·700	74·500
Nitrogen	27·280	30·900
Phosphoric acid	5·130	9·420
Sulphuric acid	3·950	3·300
Potash	11·475	5·400
Soda	1·570	1·980
Lime	6·400	11·100
Magnesia	2·670	4·520
Silica	25·100	29·000

It is easy to see, by comparison of these two analyses, that potash was the element which was deficient in the soil of the field.

The following year rye was sown, some without manure and some with a potash-manure. The results obtained left no further doubt as to the correctness of the opinion drawn from the analyses.

At the flowering-time the rye was very irregular in height, according as it had, or had not, received a dose of the potash-salts. I took samples of both, which were analysed with the following results:—

Manure Employed.	No. 1. None.	No. 2. Nitrate of Potash, 3·17 cwt. to acre.	No. 3. Sulphate of Potash, 3·17 cwt. to acre.	No. 4. Chloride of Potassium, 2·78 cwt per acre.
	Grains.	Grains.	Grains.	Grains.
Mean weight of dried stalk	10·215	24·928	22·747	24·167
Nitrogen in 1000 parts dry	12·910	8·400	9·710	6·750
Phosphoric acid ,,	5·000	4·620	4·950	5·420
Lime ,,	14·370	24·530	10·450	6·890
Magnesia ,,	13·400	1·770	2·280	1·770
Potash ,,	5·290	9·720	8·090	9·080

The rye therefore gave the same result as the wheat. Everywhere where potash was present, the returns were doubled or trebled; and in the plant itself, the proportion of potash was very nearly doubled, while the greater part of the other elements were in lessened proportions. Since that time the field has always been cultivated with potash-manure, and it has invariably produced good cereal and even beetroot-crops, which latter require more potash than most other crops.

Second Example.—In November 1877, having been consulted by M. de Hédouville, a landowner at Chantilly (Oise), as to what could be done to better the condition of a very unproductive piece of old grass-land, I asked for a sample of the soil and analysed it. This analysis gave me the results shown at No. 23 of the table of analyses of soils, and which I reproduce here.

	In 1000 parts.	In 1 Acre, 7·874 Inches deep (= 20 Centimetres).
		Tons.
Nitrogen	10·07	16·03
Phosphoric acid ..	·93	1·48
Lime	325·85	519·03
Magnesia	7·31	11·64
Potash	·22	·35

There was no room for doubt. Here was a soil totally exhausted of potash, and remarkably rich in all the other elements, especially nitrogen and lime. I accordingly advised breaking up and treatment with potash-manure. Having asked M. de Hédouville for the results obtained, I received his reply, dated 8th February last:—

"Here, in accordance with your wish, are the facts relating to the cultivation of some very old peaty grass-lands which form a part of my farm. The first start left nothing to be desired, and the crop presented an excellent appearance for six weeks; after this the vegetation received a check; the maize-plant became yellow, and did not attain a height of more than 39 inches. The idea occurred to me of asking you to analyse this soil, which was found to be very rich in nitrogen, but absolutely deficient in potash. Since consulting you, I have employed potash-manures in sufficient quantities, and the transformation has been as complete as it was sudden. My maize is now from 9 to 10 feet high, and, at a rough guess, the return per acre cannot be less than from 32 to 36 tons. I have also as good roots as are to be seen at the best exhibition, and similarly so with grain-crops; but the grain attains complete maturity with difficulty. If I had not discovered that my land wanted potash, I should have been put to long and costly experiments without taking into account the fact that I might never have found out the true cause of my ill-success. I do not mean to say that entire trust should be put in the analysis of a soil, but I am convinced that it ought always to be analysed, in order to serve as a guide in cultivating and treating our land."

"In order to make money at farming in the present day we must not go to sleep, and some money is sure to be lost if the means which are offered by science to help us to defend ourselves are neglected."

I could multiply examples of this kind, but the two just quoted will be sufficient to make it clear that the breaking up of grass-lands is only profitable when made for the express purpose of restoring to the soil those elements of which it has been exhausted by the production of hay during a series of years.

Now these elements are chiefly potash and phosphoric acid, for grass-lands consume them to a large extent: and their exhaustion is, generally speaking, the fundamental cause of the smallness and poorness of the crops. We can always discover by analysis the condition of the land in this respect. It may happen that one only, and not both, of these elements is deficient; and therefore it is more economical and preferable to supply, at least for a certain time, only that one which is chiefly in defect, for the purpose of re-establishing most

speedily the equilibrium which is favourable to good cultivation. Analysis gives an equally clear idea as to the amount of calcareous and nitrogenous matter which exists in the soil. If it is poor in lime, lime must be laid on with those crops which follow the breaking-up of the grass-land, for the purpose of rendering assimilable the nitrogen which is necessary to their well-being. But lime ought only to be employed in moderation, so as not to overstep the mark, and so bring about too active a nitrification, which would cause the grain-crops to be *laid*, and prodigally waste the nitrogenous materials which are accumulated in the soil.

These reserves are precious, and if on the one hand it is useful to draw upon them, it would be a very shortsighted policy to waste them recklessly. As the most luxuriant vegetation can only absorb annually a small quantity of nitrogen, it is important to introduce lime only in such proportions as to render assimilable the quantity of nitrogen necessary for the growing crop.

One must be guided in this matter by the appearance of the crop. If of scant growth, and of poor colour, the quantity of lime should be increased. On the other hand, it should be diminished if the growth is too quick, the colour too deep, the ripening difficult, and the laying of the crops frequent. When the soil is rich in lime, the employment of lime is not only useless, but will certainly be positively prejudicial, for the reasons I have given. In such a case the difficulty will be to regulate the action of the lime which the plough brings up and mixes with the superficial nitrogenous layer. The most simple means of effecting this is to gradually mix the superficial humus-holding layer with the subjacent lime by shallow ploughing at first, and subsequently by ploughing deeper and deeper. But since good cultivation demands a soil deeply stirred, the plough may be followed by a subsoiler, so that the soil may be stirred to a suitable depth.

In certain cases we may by a deep ploughing bury the superficial layer, and afterwards bring it up again gradually by shallow ploughings, keeping the soil in a suitable state of lightness. These methods are based on the fact, that nitrification, which decomposes nitrogenous matter, and makes it assimilable, only takes place in the superficial layers of the soil which are permeable to the oxygen of the air.

After some years of cultivation, carried on under the conditions which I have indicated, the land can be laid down to grass again, if it is deemed expedient; but in the great majority of cases it will be found preferable to continue arable cultivation, for it will continue to be remunerative so long as the soil remains rich in nitrogenous matters.

From all that has been stated, we can now draw the following practical and economical conclusions:—

1st. That the cultivation of roots and cereals deprives the soil of nitrogen, whilst that of grass and leguminous plants, temporary or permanent, on the contrary, causes it to accumulate in the soil. That nitrogen being the most expensive manure to buy, it is not economical to devote part of the land absolutely to arable and part to grass, for whilst the one uses up the nitrogen, the other accumulates it in excess. On the contrary, it is preferable to alternate on the same piece of land the cultivation of roots and cereals with that of grass leys, so as, in a measure, to repair by the second the loss of nitrogen which the first cause to the soil. By this means cultivation can be kept up indefinitely, without purchased nitrogen, provided that the land be maintained in a fit state of richness as regards the mineral elements which are indispensable to healthy vegetation.

2nd. The practical application of this principle is, that the temporary occupation of the land by a grass ley for two or three years, which takes its turn in the rotation of crops, should be preferred to permanent occupation by grass. We thus secure the improvement of the soil obtainable from the cultivation of clover, lucerne, vetches, &c. But as this class of plant will not succeed on every soil, temporary "leys" with graminaceous herbage ought to give, where leguminous plants do not succeed, analogous if not equally good results, and so assist us materially in solving the problem of producing cereal, root, and other crops, with increasing economy.

VIII. *On Lard Cheese.* By X. A. Willard, of Little Falls, Herkimer County, New York State.

[In a Letter to the Editor.]

Dear Sir,—Knowing your interest in anything *new* as regards the dairy, I send you herewith my notes on an experimental creamery, which I visited on November 16, together with a drawing showing the construction and machinery of Wire's cheese vat.

From the cut (p. 226), and the accompanying description, I think you will be able to form a good idea of the apparatus.

You have no doubt heard of a somewhat recent practice at some of our creameries for improving skimmed milk in cheese-

making by the use of lard. The lard-cheese from Whitman and Burrell's creamery has been sent to the West Indies and to other warm climates, and I have been informed that the goods hold favour and sell at a good price. The profits, in manipulating "blue skim milk" with lard for cheese-making, are very considerable, and many creameries in time are likely to enter upon this manufacture. The use of fats and oils in "skim-cheese" has been tried from time to time for a number of years, but the practice could hardly be said to be a success, as there was difficulty in making a perfect emulsion. The invention of the machine for cutting and distributing the fats has nearly or quite overcome this difficulty. There is much feeling among our dairymen against the making of this adulterated product, fears being entertained that if largely made and exported it will injure the sale of genuine whole-milk cheese. I think it not improbable that very strict laws will be passed regulating the sale and export of lard-cheese. I am told that parties have shipped this cheese to England, and that experts were unable to detect the adulteration, and I have seen samples that would pass unsuspected for whole-milk cheese, both as to texture and flavour.

On the 16th of November I went down to the Whitman and Burrell factory, to see the operation of "Wire's Circular Self-agitating Cheese Vat." The factory, it may be remarked, had closed work for the season, and the milk collected for the day's trial had been gathered not only to test Mr. Wire's invention, but to show also the manipulation of the milk in making what is known as "lard cheese," which of late has obtained considerable notoriety through the newspapers and otherwise. The factory, or more properly the creamery, is located about 1½ miles east of Little Falls, on the south side of the Mohawk river, and just below where the stream emerges from the narrow mountain gorge. The land below the creamery is composed of upland and flats; the former, descending some little distance to the flats, is more or less broken, but affords good pasturage. After reaching the ascent that borders the flats, the lands spread out into a level and rolling surface, and are fertile and valuable, whether for grain or dairy purposes. All this region, however, is for the most part devoted to dairying. A few hops may be grown on some of the farms, and a little grain—wheat, corn, and oats—sufficient for home wants.

The creamery building is 80 feet by 40 feet, two stories and a half, and was originally erected as a cheese factory, but since its purchase by the Messrs. Whitman and Burrell, has been converted into a creamery. The milk of about 200 to 300 cows is taken here, and is purchased direct from the farmers, the price

paid being regulated on the basis of 10 lbs. of milk for 1 lb. of cheese, and at the highest market value for cheese at the Little Falls market. This gives the farmers, on an average, better receipts for their milk than by working the factory on their own account, since there can be no loss at any time on account of imperfect cheese, which sometimes occurs to the best of factories managed on the co-operative plan.

The milk, after its delivery at the creamery, is run into large vats provided with an arrangement for cooling quickly with cold spring water, after the plan of the Whitman and Burrell milk-setting vats. The temperature of the water, of which there is an abundant supply, is 50° Fahr. The milk remains in the vats in summer (June and July) from 24 to 36 hours, and in September and October often 72 hours, the object being to get all the cream possible from the milk, as the "bluest skimmed milk" works best in its manipulation with lard for cheese-making, an account of which will be given further on. The quantity of butter taken from the milk during the summer is at the rate of 4 lbs. to the 100 lbs. of milk. In the month of October, when milk is richer, the average was 4½ lbs. of butter to 100 lbs. of milk.

The cream is churned in one of Blanchard's large factory churns, and the buttermilk is added to the skimmed milk, which is then converted into cheese. In this process 1½ lbs. of lard to 100 lbs. of milk is added to the skimmed-milk and buttermilk, in order to compensate in part for the butter-fat removed. Butter-oil is also employed instead of lard when prices for a low grade of butter are low enough to make its use profitable. The butter-oil is made by clarifying poor butter, and the loss on such butter, on account of its purification, is from 25 to 30 per cent. This waste or loss consists of water, salt, and casein contained in the butter. Mr. Burrell stated to me that when lard is employed the very best quality of kettle-rendered lard is obtained, as it is essential to have a pure odourless fat to ensure a good flavour in the cheese.

One notable circumstance in adding lard or butter-oil to skimmed milk is that the weight of cheese from a given quantity of milk is increased, not only by the weight of lard added, but nearly as much more weight is gained by the tendency of the curds, after the fat is added, to retain the moisture. In other words, if 1½ lbs. of lard is added to 100 lbs. of skimmed milk, it makes nearly 3 lbs. more product than could be obtained from the skimmed milk if made up without any addition of fat. The trouble heretofore in making a "thorough-bred blue skim" cheese was the difficulty in its retaining a proper amount of moisture to assimilate in the curds while

curing. Hence a "blue skim cheese" generally turned out hard and dry, and was appropriately named "white oak cheese." Some years ago I pointed out this circumstance in discussing the office of fat in milk for the purpose of cheese-making. A good rich cheese contains, when mature or ready for eating, about 33 per cent. of moisture, and this moisture must be so minutely distributed through the parts—so assimilated—as not to be recognised as moisture when a bit of cheese is mashed under the finger, but rather to give the impression that the goods are stocky, or rich in butter.

By the term "blue skimmed milk" is meant milk that has yielded all the butter-fat that can be obtained from it in the usual process of setting. In the manufacture of artificial cream from lard and skim milk, to mix with the mass of skim milk and buttermilk in the vat, it is found, if the butter from the original milk has not been thoroughly removed, that the lard-fat and the butter-fat do not mix well together; hence, to get a perfect emulsion of lard, the best results are obtained in working with a blue skimmed milk.

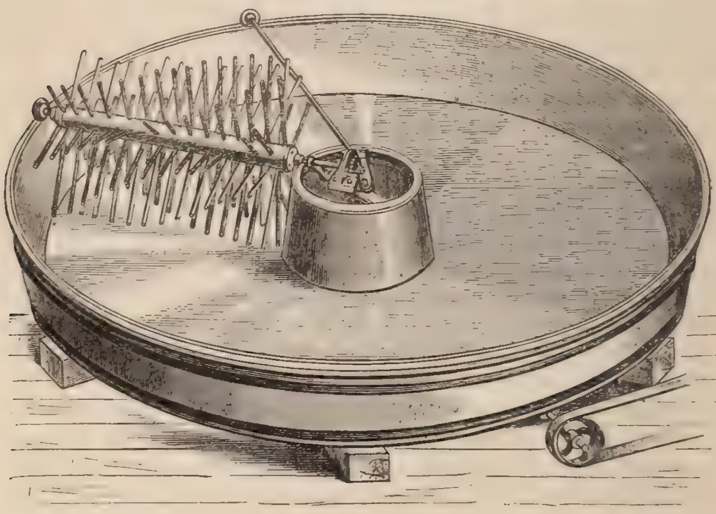
In making the "lard cream" to be added to the skimmed milk, a machine ingeniously constructed is employed. It may be briefly described as a cylinder, 6 inches in diameter and 20 inches long, having 50,000 points cut upon its surface, and arranged in spiral courses. This cylinder is enclosed in a shell fitting closely. It stands perpendicularly in a frame, with shafting and pulley at the bottom connected with the engine, and is made to revolve at the rate of 2500 to 3000 revolutions per minute. Two tin cans, with faucets, stand on the top of the machine, the one for the melted lard and the other for the skimmed milk. The faucets are arranged so as to convey the contents of the cans at one point together into the machine. The lard and milk are heated to a temperature of 130°, when the cylinder is set in motion and the faucets are opened, allowing the milk and lard—in the proportion of two parts of the former to one of the latter—to flow into the machine. The rapid revolution of this cylinder, the surface of which is set with thousands of small points, causes the lard to be divided into minute globules, which are encased or surrounded with the casein of the milk, making a perfect emulsion, similar to the butter globules in the original milk. Thus the lard and milk being united form a thin cream, which flows from the machine into large tin pails or cans, and is immediately mingled with the skimmed milk in the vat.

The milk is set at a temperature of about 90° Fahr., Hansen's extract of rennet being used at the rate of 3½ to 4 ounces extract for 1000 lbs. of milk. It is preferred to have coagulation take place in about ten minutes, and the top of the mass is

stirred gently with the hands until the milk begins to thicken. The curds are cut over three times; first with the horizontal knives, and then twice with the perpendicular knives. The curds are scalded or cooked in the usual way, the temperature being raised to 94° or 100° Fahr., and from 2 to 2½ lbs. of salt are applied for 1000 lbs. of the original milk. The time of raising the heat in cooking, when milk is all right, is from 1 to 1½ hours. The ratio of milk to a pound of cheese, calculated from the original milk, or milk as delivered at the factory, was for June 12 lbs. In July it took 12·6 for one of cheese, and in October 10 lbs.

Having briefly described the method of manipulating milk at this creamery, an account of the operation of Wire's self-

Wire's Self-acting Cheese-vat for making Lard Cheese.



acting cheese vat will now be in order. The vat or tub consists of two parts—the outer of wood, and the inner, or milk-vat, of tin, with a space between the two, in which are placed pipes for heating. The wood vat is made in the shape of a tub, from 10 to 14 feet in diameter and 20 to 22 inches deep. The one shown at the creamery was 10 feet 8 inches in diameter and 21 inches deep. It is cut in the centre of the bottom, within which staves are set up of the same height as the outside. The tin is also tub-shaped, and made with a core to correspond with the wood. A shaft, upon which is fixed the agitator for stirring the curd, extends from the centre of the vat horizontally across its top to the outer edge.

By means of suitable machinery, situated in the core, a radial

motion about the centre of the vat is given to this shaft at the same time that it revolves upon its own axis. The agitator is furnished with long teeth, which reach to the bottom of the tin vat. They are set spirally on a wooden cylinder. Thus, in operation, while the agitator revolves on its own axis, the shaft by which it is carried swings about the centre of the vat, bringing it to every part of the vat, and agitating the whole mass of curd perfectly and evenly. As soon as the agitator begins to work in the process of scalding and cooking the curd, a current is formed around the vat, which keeps every particle constantly in motion, and removes the danger of uneven cooking. The motion of the agitator being uniform and steady, the curd is handled more carefully, and with less loss in the whey, than is usual with the hand stirring. When not in use, the agitator is readily lifted out of the curd and tipped back until it stands vertically over the centre of the vat. An arm is also provided, to which knives for cutting the curd are attached.

In the trial, about 6000 lbs. of milk were in the vat, and when the curds were ready to cut, a horizontal knife was attached to the iron arm, which moved slowly about the vat. Afterwards the perpendicular knife was attached, cutting the curd perpendicularly. The common knives were used in this operation, but I understand that knives specially adapted to the machine should be used. The operation of cutting appeared to be satisfactorily performed. When it came to stirring the curds, the advantages were very apparent, and elicited commendation from those present. The whey was drawn from the bottom of the vat at a point near the outer edge. The vat was then tilted, the agitator working equally well on the incline, and keeping the curds fine and in good condition for salting. Finally the salt was applied, and the agitator did the stirring, incorporating the salt evenly, and leaving the curds in excellent shape for the press. The advantage of this machine for keeping all parts of the curds exposed to the atmosphere for any length of time desired is a commendable feature, which will be at once recognised by cheese-makers. The agitator does the work of the curd-mill, and obviates its use.

I think that all present were well satisfied with the trial as a success, and that Mr. Wire had made a great and exceedingly useful improvement for manipulating the curds in cheese-making. There is one question, however, which occurred to me, as it did to some of those present at the exhibition. It is this: These vats are made to manipulate from 10,000 to 12,000 lbs. of milk or more in one vat, and the massing of a large body of milk from different patrons, when some happens to be bad, must affect the whole mass injuriously. Under the pre-

sent system of several vats, all suspected milk may be massed together in one vat and made up separately. To this objection, some of the cheese-makers present replied that the cheese-makers must not accept bad milk, but send it back; that the cheese, under this system, would be uniform for the day, and that this would be an advantage, at least. Again, it necessitates the additional cost of an engine, as many factories, under the present system, use only a boiler. I am not disposed, however, to criticise or offer objections to what appears to be plainly an improvement, and even if I did, some of these would be answered, perhaps, by the following claims of the inventor:

"First, that these vats perform nearly the entire work of stirring the curd, during the process of cooking and salting, by machinery, dispensing with the use of an extra curd-drainer or sink, and doing the work as perfectly as it can be done, and much more perfectly than it is usually done by hand.

"Second, that by their use one man will easily do the work of two or three men, using common vats.

"Third, an increased yield of cheese in consequence of their use."

These vats appear to be very substantially made, and for persons about to erect new factories, or renew apparatus, it would be well to examine their operation.

In conclusion, a word may be added in regard to the lard cheese shown me at this establishment. The curing-rooms contained the September, October, and November makes. Quite a number of cheeses of different ages were cut with the "cheese-trier's iron," for the inspection and taste of those present. A good deal has been said from time to time in the papers about lard cheese. I have heard dealers speak of it as poor nasty stuff, which was doing great injury to the trade—often lying on the docks or in the storehouses of New York, unsold and unsaleable, except at a price "ruinously low." I have never advocated the making of lard cheese, and must confess I have been prejudiced against it; but this should not prevent me from giving a truthful account of the cheese offered for my inspection.

The cheeses bored for us were mellow and clean-flavoured, and might be fairly classed, I think, under what cheesemongers denominate a "useful article." They were not, of course, equal to fine whole-milk cheese, but no one (who knew nothing of their make) would be disposed to call them "skimmed cheese." Dr. Wight and the other experts present agreed with me in this opinion, and expressed their surprise that so good an article could be made from "blue skimmed milk." But perhaps the best proof of what I have said is in the sale of the product during the past summer. The prices obtained, as I was informed, were within from 1 to 2 cents per lb. of whole-milk cheese sold on the Little Falls market.

That the lard cheese made at this factory has unquestionable merit, no one I think can reasonably deny: and this leads me to say that cheese as good as this ought to sell on its merits and under its own name to distinguish it from whole-milk goods, since it is right that the consumer should know what he is purchasing. As to lard cheese made elsewhere I cannot speak, not having had sufficient opportunity of testing its quality. I suppose "lard cheese," however, is no exception to other kinds, and that its goodness and character depend considerably upon the skill of the maker.*

IX.—*On Laying down Land to Permanent Grass.* By C. De Laune Faunce-De Laune.

I have been requested to indicate the course which, in accordance with my experience, ought to be adopted to insure with certainty and rapidity the formation of permanent pastures.

Although I have, during the last nine years, bestowed much attention on the formation of permanent pastures, I should have hesitated to undertake the task of attempting to enlighten others, had I not been assured by many very competent advisers that a promulgation of the results of my experience would be greatly for the public advantage; the more so, as on many essential points my views differ materially from those of most writers on the same subject.

Perhaps, in some details, further experience will justify modifications in my present convictions, as every season alters to the close observer the aspect of a pasture. And no doubt the changes during the last five years have been very marked, as the seasons have been so exceptional.

In the limited space of this article, I intend to confine myself to that which I deem the most important: viz., the kinds of seed suitable to be laid down.

Unfortunately for owners and occupiers of land, the grossest ignorance prevails about grasses. To many landowners and farmers almost every herb that is green is considered to be grass; hence the ordinary circumspection used in purchasing grain-crop seeds has not been exercised in the case of grass-seeds.

It is generally, I might almost say invariably, alleged, and truly so, that newly formed pastures have been found to deteriorate greatly after the first two or three years.

* A sample of lard cheese and one of oleomargarine cheese sent to me by Messrs. Burrell & Whitman arrived as the 'Journal' was going to Press. I can endorse all that Mr. Willard says about the quality of the lard cheese and the name under which it should be sold. The latter remark applies equally to the oleomargarine cheese, but its quality was very superior; in fact it could not be readily distinguished from ordinary American cheese of commerce.

I will explain my view of the reason of this deterioration, and point out the remedy ; and, in so doing, correct what I conceive to be some erroneous impressions that are generally entertained respecting grasses.

The terms "coarser grasses" and "finer grasses," which are so frequently used, have led to serious mischief in the formation of new pastures. The coarser are popularly believed to be the inferior, and the finer grasses the better sort ; but in reality the four best grasses for pasture are all large grasses, and come, popularly speaking, under the head of coarse grasses.

The number of grasses indigenous to England is very considerable ; but it is sufficient for all purposes of practical utility to indicate those that are the most valuable and those that are the most detrimental to all pastures, whether new or old.

There are perennial, biennial, and annual grasses ; the two latter ought, in my opinion, under all circumstances, to be carefully excluded when a permanent pasture is desired. The use of short-lived grasses and of biennial clovers, coupled with an insufficiency of proper seed, is the main cause of the deterioration of new pastures after the first two or three years.

The four coarse grasses, valuable beyond all others for permanent pasture, are cocksfoot (*Dactylis glomerata*), meadow fescue (*Festuca pratensis*) and its ally, tall fescue (*Festuca elatior*), catstail or timothy (*Phleum pratense*), and meadow foxtail (*Alopecurus pratensis*). These five grasses should form the bulk of all pastures on good soil, either for sheep or cattle. The finer or minor grasses are crested dogstail (*Cynosurus cristatus*), hard fescue (*Festuca duriuscula*), rough meadow grass (*Poa trivialis*), fiorin (*Agrostis stolonifera*), sheep's fescue (*Festuca ovina*), and golden oat-grass (*Avena flavescens*). A meadow composed of the above would be perfect as regards grasses, assuming that the proper proportions are used ; it would produce food for stock during nearly every month of the year. The clovers, which should, however, be used in a much smaller proportion than the grasses, are permanent red clover, cow grass, alsike, and white or Dutch clover. Seeds of milfoil or yarrow (*Achillea millefolium*) ought never to be omitted. The above are really all the plants required for a permanent pasture of the finest quality, on first-rate or medium soils throughout Britain. On inferior soils, or soils possessing special qualities, some of these grasses would not be suitable, and a selection must be made. Thus on dry lands, foxtail, rough meadow grass, and fiorin should be omitted, and a smaller quantity of meadow fescue used, while a greater proportion of cocksfoot, crested dogstail, and yarrow should be substituted.

The grasses most pernicious to newly formed pastures are first and principally rye-grass in all its varieties, and York-

shire fog or soft woolly grass (*Holcus lanatus*). Both these grasses are rapid in growth and make a great show, hence their popularity with superficial observers and seed-merchants; they produce an abundance of seed and are very cheap. Enormous profits are made by the sale of them, and, what is worse, incalculable loss is entailed upon those who sow them for permanent pasture. My experience is that mixtures sold throughout the country for permanent pasture consist principally of rye-grass. And as these mixtures are sold at prices varying from 8*d.* to 10*d.* per lb., whilst the rye-grass seeds, of which they principally consist, can be purchased for 1½*d.* per lb., it requires no great skill to calculate the vast profits which must accrue to those who supply them.

In relation to the life of the plant, grasses may be divided into two classes, those which flower and seed once only and then die, and those which continue to flower and seed and yet live.

The first are generally called annual grasses, but it should be observed that annual grasses kept down by stock, or cut before seeding, may continue to live for years until they seed; after seeding they die. All the grasses which I have mentioned above, with the exception of rye-grass, are perennial, and do not die upon seeding, whilst all rye-grasses, or nearly all, die after once seeding; unless, therefore, the seed is permitted to mature, fall, and germinate in the field, those grasses disappear from the pasture. To the presence of annual grasses, and to this alone, do I assign the deterioration of the large majority of newly-formed pastures. The seed mixtures usually supplied for laying down land to permanent pasture consist of so large a proportion of annual grasses that the speedy deterioration of the pastures is inevitable.

The pamphlets written by different seed merchants are extensively read, and the suggestions contained in them are adopted by the public. I will now examine the pamphlets of five of the leading seed merchants, and afterwards I will briefly notice a few of the principal other works on grasses, so that any who desire information may themselves refer to these pamphlets and books.

Messrs. Carter's pamphlet is noticeable in this way, that, were their instructions carried out, it would, in my opinion, be almost impossible to get a permanent pasture. Under the heading of "Italian Rye-Grass" we find the following at page 27; "Italian rye-grass is too well known to require much description here. Although only a biennial we consider Italian rye-grass a most useful element in permanent pasture mixtures. It is of very quick growth, giving a good swarth to the scythe for the first year's hay-crop, and by reason of its rapid growth, is of considerable value to the aftermath." When we consider the great

proportions of this Italian rye-grass recommended in some of their mixtures, it is not to be wondered at, in my judgment, if disappointment should follow the adoption of their advice. It is curious, that although they, like all others, speak highly of cocksfoot, they nevertheless recommend a quantity comparatively small,—4 lbs. being the most recommended in any mixture for one acre. Again they say, page 28, "perennial rye-grass is necessary in all mixtures for permanent pastures."

Their preliminary remarks respecting the preparation of the land may be read with advantage. I must, however, quote the following passage referring to the seeding of grass lands:—

Messrs. Carter say (page 6): "We have occasionally seeded down pastures, &c., in prominent public positions (notably at the Kilburn and Carlisle shows of the Royal Agricultural Society, the Paris, Sydney, Vienna, Melbourne, and other Exhibitions, &c.), which were admired for their compactness and general excellence, and when asked to explain how such a thick sward may be produced in so short a time, the explanation is fine tilth, good heart, cleanliness, and liberal seeding as the main requisites; and the more important points in which our treatment differs from ordinary methods, in addition to the above, lie in a careful adaptation of the seeds to the peculiar physical formation of the soil and the judicious proportion of quantities."

A rather different, and in my opinion a more correct, explanation of these admired show samples is given in the Report on the Showyard at Derby by the Senior Steward, published in the last number of this 'Journal,' p. 545, to which I ask the especial attention of the reader.

In Messrs. Carter's account of the after-management of newly formed grass lands, they recommend mowing grass and deprecate the feeding off of newly formed pastures by sheep; in this point my experience differs from theirs. Messrs. Carter state "sheep reject the coarser grasses and pick out the finer kinds" (page 8). I cannot too strongly insist on the fact, that among the best feeding grasses are some of strong and "coarse" habit, while among the finer kinds many worthless grasses are to be found. Messrs. Carter's account of the geological formation of soils may be interesting and perhaps useful, but my experience is that disappointment will follow if the seeds they recommend are sown, however carefully. All their instructions, respecting sowing and, as I have already said, the preparation of the soil, may be carried out with advantage.

The Messrs. J. C. Wheeler and Son, in their 'Book on Grasses,' lay great stress on the judicious selection of seed, for they hold that unless this is done, although the crop may appear luxuriant, it will soon show signs of deterioration, "as the artificial grasses die out before the natural grasses are esta-

TABLE I.—MESSRS. CARTER and CO.'s LIST for MEDIUM SOILS without a CROP (page 21).

	Quantity Sown per Acre.	Number of Seeds of each Species of Plant in the Quantity Sown.	Percentage of the Seeds of these Plants which usually Germinate.	Number of Seeds in the Quantity Sown which may be expected to Germinate.	Number of Seeds of the superior Grasses which should Grow.	Number of Seeds of the secondary Grasses which should Grow.	Number of Seeds of Rye-grass, Clovers, &c., which should Grow.
	lbs.						
Sweet Vernal	1	758,299	60	454,979	..	454,979	..
Meadow Foxtail	2	620,730	20	124,146	124,146	..	..
Cocksfoot	4	1,812,924	60	1,087,754	1,087,754	..	..
Hard Fescue	2	807,312	60	484,387	..	484,387	..
Sheep's Fescue	2	807,312	60	484,387	..	484,387	..
Darnel-leaved Fescue	1	403,656	60	242,193	..	242,193	..
Meadow Fescue	2	467,060	60	280,236	280,236	..	..
Italian Rye-grass	9	2,641,599	90	2,377,439	..	..	2,377,439
Pacey's perennial Rye-grass	5	1,467,555	90	1,320,799	..	..	1,320,799
Timothy	4	3,251,804	90	2,926,623	2,926,623	..	..
Wood Meadow grass	1	1,531,860	60	919,116	..	919,116	..
Perennial Red Clover	4	924,812	100	924,812	..	..	924,812
Perennial White Clover	4	2,626,044	100	2,626,044	..	..	2,626,044
Alsike Clover	1	656,511	100	656,511	..	..	656,511
Yellow Trefoil Clover	3	1,969,533	100	1,969,533	..	..	1,969,533
	45	20,747,011	..	16,878,959	4,418,759	2,585,062	9,875,138

TABLE II.—MESSRS. J. C. WHEELER AND SON'S MIXTURE for MEDIUM LONDON CLAY (p. 17).

	Quantity Sown per Acre.	Number of Seeds of each Species of Plant in the Quantity Sown.	Percentage of the Seeds of these Plants which usually Germinate.	Number of Seeds in the Quantity Sown which may be expected to Germinate.	Number of Seeds of the superior Grasses which should Grow.	Number of Seeds of the secondary Grasses which should Grow.	Number of Seeds of Rye-grass, Clovers, &c., which should Grow.
	lbs.						
Cow-grass	3	900,000	100	900,000	..	..	900,000
Perennial White Clover	4	2,626,044	100	2,626,044	..	..	2,626,044
Red Clover	2	462,406	100	462,406	..	..	462,406
Yellow Trefoil	3	1,969,533	100	1,969,533	..	..	1,969,533
Birdsfoot Trefoil	$\frac{1}{4}$	164,127	100	164,127	..	..	164,127
Kidney Vetch	$\frac{1}{4}$	2,500	100	2,500	..	..	2,500
Timothy	3	3,438,853	90	2,194,967	2,194,967	..	..
Sheep's Parsley	1	..	..	..	..	..	..
Sheep's Fescue	2	807,312	60	484,387	..	484,387	..
Hard Fescue	1	403,656	60	242,193	..	212,193	..
Meadow Fescue	2	467,060	60	280,236	280,236	..	..
Smooth Meadow-grass	$2\frac{1}{2}$	3,962,552	60	2,377,531	..	2,377,531	..
Sweet Vernal	1	758,299	60	454,979	..	454,979	..
Meadow Foxtail	1	310,365	20	62,073	62,073	..	..
Golden Oat-grass	1	200,000	60	120,000	..	120,000	..
Evergreen Rye-grass	$5\frac{1}{2}$	1,614,310	90	1,452,879	..	..	1,452,879
Pacey's Rye-grass	4	1,174,044	90	1,056,639	..	..	1,056,639
	$36\frac{1}{2}$	19,261,061	..	14,847,994	2,537,276	3,679,090	8,631,125

blished" (p. 12). Had Messrs. Wheeler substituted the word annual instead of artificial, and perennial instead of natural, they would have given, as I believe, the true cause of the deterioration of newly sown pastures.

Messrs. Wheeler also mention that deterioration is "particularly observable when the so-called cheap mixtures are used, which are principally composed of Italian rye-grass." It was my misfortune, before I had learned by sad experience, I fear in common with many others, who, like me, have purchased mixtures at either a great or a small price, to be greatly disappointed after the first two years.

It will be observed by the examination of Messrs. Wheeler's and Messrs. Carter's mixtures for permanent pasture, as set out in Tables I. and II., how extremely small is their proportion of the grasses which my practice teaches to be good for such pasture. As, moreover, my experience has satisfied me, and in this I am fully confirmed by Mr. Carruthers, that, whereas upwards of 90 per cent. of rye-grass seed will germinate, the highest percentage of germinating seed in the permanent grasses mentioned in the following table is 60 per cent., and in the case of foxtail only 20 per cent., it follows that nearly half the grass seeds in these mixtures produce annual plants, and the remainder only are useful for permanent pasture.

In the several Tables the number of seeds per pound are taken from Sinclair (page 245), with the exception of golden oat-grass, cow-grass, rib-grass, and trefoil. Subsequent calculations suggest that the actual number of seeds per pound may be considerably higher than Sinclair's estimates. But as I have not been able to test these, and have formed a high opinion of Sinclair's general accuracy, I have used his numbers in these Tables.

In Messrs. Webb and Sons' pamphlet on the formation of permanent pastures, the following remarks on the after culture and management of newly formed pastures will be found at p. 5:—"In no case should the young seeds be stocked with sheep the first season, for, if so, much of the plant, especially the clovers and fine grasses, upon which the sheep delight to feed, will assuredly be lost, being pulled up altogether, or the crowns would be so bitten down that the plant may have difficulty in withstanding the rigours of an inclement winter." Again, p. 5:—"We have a great aversion to the grasses of old or new permanent pastures being allowed to seed before they are cut for hay, for experience teaches us that many plants die altogether if allowed to ripen off after reproduction, and but few make vigorous growth afterwards." And at p. 7:—"Many of our readers will have observed on newly-sown land, where little attention has been given either to the quality or

selection of the seed sown, that after showing great luxuriance for a year or two, gradually the pastures sicken and lose plant, the vacancies in time filling up with the natural and perhaps foul grasses indigenous to the district, and then both time and money have been lost." This statement many persons who have attempted to form permanent pastures have undoubtedly found but too true, even when they have gone to the seed-merchants of the greatest repute, and have ordered seeds which they believed to be of the finest quality, and have paid accordingly.

I think that there need be no difficulty in discovering the necessity for these careful instructions and the cause of the loss, to the purchaser, of both time and money, if their list of seeds be examined. I find that Messrs. Webb and Sons recommend rye-grass, but in what proportion I cannot ascertain from their list, as they do not mention the quantity or "proper proportion" of this or any other species of the plants which form the mixture they supply for permanent pasture. For light, medium, and heavy soils Webb's best mixtures contain the following sorts in proper proportions:—

Alsike.	Evergreen rye-grass.
Sweet-scented vernal.	Webb's imperial giant cow-grass.
Cocksfoot.	Greater bird's foot trefoil.
Rough-stalked meadow grass.	Hard fescue.
Cow-grass.	Wood meadow grass.
Tall fescue.	Meadow catstail.
Crested dogstail.	Yellow trefoil.
Sheep's fescue.	Meadow fescue.
Webb's giant white clover.	Red clover.
Evergreen meadow grass.	Meadow foxtail.
Sheep's parsley.	

Messrs. Webb say (p. 6): "It is not the pasture that produces the greatest bulk of herbage that is the best, but those that possess the grasses of the finest quality; hence the saying: 'Better to have a lark than a kite.'" This statement is directly opposed to my own experience and observation, for pasture formed principally of the four larger, or as they are incorrectly called, "coarser" grasses, which I have already named, will, with a mixture of the finer grasses and clovers to fill up interstices, produce not only the greatest bulk of herbage, but one also of the most nourishing quality.

Mr. Martin Sutton's pamphlet on grasses is in many points valuable, especially the part devoted to descriptions of agricultural grasses. I would especially call attention to the high estimation in which he holds cocksfoot. Under his so-called Sutton's improved rye-grass, he says it is more important in alternate husbandry than for use in permanent pastures; yet Messrs. Sutton include rye-grass in their mixtures for permanent pasture. In the account of Sutton's perennial rye-

grass, we find it stated that "it is invaluable for permanent pasture, as it produces a bulky crop;" but in his account (at p. 31) of *Festuca loliacea* he says: "This very valuable variety is most closely allied to, and is sometimes mistaken for rye-grass (as its name implies). It is, however, easily distinguished from rye-grass, being short-stalked, and having always two outer glumes or pales. It also differs essentially from rye-grass in the fact that it improves as it gets fully developed." Mr. Martin Sutton, then, is of the same opinion as myself, that rye-grass does not improve in the same ratio as permanent grasses; but if such is the case, why does he recommend rye-grass, when other grasses that are certainly permanent, and continue to improve, can be substituted? Many of Mr. Sutton's recommendations as regards the preparation of the land for the sowing of grass-seeds are valuable. I would notice, however, that he disapproves of sowing rape with the grass-seeds, and recommends corn; whereas my experience is, that the sowing of rape with permanent grass-seeds is much to be recommended. His remarks about the injury done to a pasture by sowing the sweepings of the hayloft are invaluable. Another important piece of advice, with which I entirely agree, is, that "useless grasses are, indeed, most serious weeds." His statement that Italian rye-grass "is frequently recommended and extensively used, no doubt because it makes a showy appearance after the first year," agrees with the conclusion to which, after careful observation, I have myself arrived, but with this difference, that I should substitute *all rye-grass* for Italian rye-grass only. In p. 12 Mr. Sutton says: "The young grass should not be grazed till the following autumn;" and "it should never be forgotten that many of the finer grasses, if allowed to seed, are not strictly permanent on all soils." I am not aware of any grass with the properties which Mr. Sutton here describes, unless it be the annual grasses, which I have mentioned before; but I think that no ordinary amount of manure would prevent foxtail, fiorin, and rough meadow grass from dying out on very dry banks.

Mr. W. Toogood's pamphlet is certainly a useful one, and although I do not agree with him in every point, I must commend it. He does not put forward any special instructions. He says that Italian rye-grass is more suitable for alternate husbandry than for permanent pasture. He gives important advice when he recommends those who understand something of the laying down land to permanent pasture, to select the varieties and *draw out* the quantities of each kind of grass and clover for themselves. He, however, falls into the same error as the other seed-merchants respecting the coarser grasses, in believing that the fine grasses are necessarily of the best quality.

Mr. Toógood, under the heading of *Festuca pratensis,* says: "this is one of the most nutritious and productive of the natural grasses, as it contains many of the properties without the defects of our common rye-grass." But when he holds such an opinion as this, how can he recommend the sowing of rye-grass, with its acknowledged defects, on soils suitable for the nutritious and productive meadow fescue?

Thus far I have examined the trade pamphlets of seed merchants. I will now refer to works containing the results of investigations by practical and scientific men unconnected with the seed-trade.

The best book, in my judgment, for practical knowledge respecting cultivation of grass is Sinclair's 'Hortus Gramineus Woburnensis,' in which the most exact information can be found in regard to all our grasses; and although the scientific experiments made by Sir Humphrey Davy as to the feeding properties of the different grasses may be considered antiquated and deficient in the minute analyses with which we are familiar in our days, they nevertheless afford a fair indication of the relative values of the grasses, and may, I believe, be trusted in determining our selection of seeds. Some of the statements respecting the value of different grasses given by Sinclair are so astonishing that one may well hesitate to believe them, yet so accurate were his observations and so careful his experiments that I cannot discredit them without the strongest evidence. The statement that appears most open to objection and the most difficult to believe is, perhaps, the following:—"Let the produce and nutritive powers of rye-grass be compared with those of the cocksfoot grass, and it will be found inferior in the proportion of nearly 5 to 18, and also inferior to meadow foxtail in the proportion of 5 to 12, and inferior to the meadow fescue in the proportion of 5 to 17. In these comparisons, from which the above proportions arose, it was necessary to omit the seed crops for the truth of comparison."—(P. 215.)

My own experience convinces me that these proportionate estimates of Sinclair's are correct. Donaldson, however, in his work on grasses, on page 281, says, "the results above quoted will be received with much caution as practice in a great measure reverses them. No practical man will be convinced that (rye- or) ray-grass is inferior to cocksfoot, as 5 to 18 in any one respect, the latter being a very coarse grass and unfit for hay on any good lands, and chiefly adapted for pasturage on inferior soils." While Donaldson thus sets aside Sinclair's comparative value of cocksfoot and rye-grass, he appears to accept the comparative values given by Sinclair of other grasses. But if Sinclair is correct in the majority of cases, why should he be in error in this one, more especially as it is apparent through-

out his whole book that he started and continued his experiments unbiassed by prejudice? I must add that Donaldson, in his list of seeds, gives a smaller proportion of rye-grass and a larger proportion of cocksfoot than most writers on the subject.

I would next refer to the article of the late Mr. T. Carrington ('Journ.' Roy. Agric. Soc., vol. xv. p. 490), than whose opinion there are few more valuable, he says: "No person who has not had experience will appreciate fully the difficulty and tediousness of the operation of converting into really good turf, poor strong land which has been constantly under the plough for generations, and in which every bit of vegetable matter has been used up by the practice of having periodical dead fallows dressed with lime."

I can fully endorse what Mr. Carrington says, although I have never had to deal with land treated in the way he mentions. I have, nevertheless, had to deal with land extremely exhausted, but the difficulty with such land since I gave up sowing rye-grass has been greatly lessened, although, notwithstanding high feeding with decorticated cotton-cake, it still takes a long time when the land is exhausted to make it rich enough to grow grass. But my experience has proved that when land will not grow grass it will not grow grain-crops either, unless the land intended for pasture is treated in the same way as it would be for corn, that is, by fallowing or manuring. In the list of seeds given by Mr. Carrington (Table III.), nearly one-fifth is rye-grass (one-third of this quantity being Italian rye-grass), and nearly two-fifths clovers and rib-grass, so that only two-fifths consisted of perennial grasses (of which quantity little more than one-third was made up of the better grasses). I am satisfied that nothing but his liberal use of decorticated cotton-cake and his laying the grass down with rape, could have caused the small quantity of permanent grass-seed so to tiller out as to make his splendid new pastures. It is obvious from Mr. Carrington's article that he farmed his pastures, and would not leave them to nature, as most people do.

Mr. James Howard, M.P., in his report on laying down land to grass ('Journ.' Roy. Agric. Soc., vol. xvi.), does not in any way mention what seed he uses, and I therefore conclude that he has not paid much attention to the properties of different grasses. He says that in his first experience his pastures began to fail after three or four years, and never until the tenth year were the grasses well established, and he came to the conclusion that there was much truth in the Suffolk couplet,

> "To break a pasture will make a man,
> To make a pasture will break a man."

TABLE III.—MR. CARRINGTON'S MIXTURE of GRASS SEEDS for a SIX-ACRE FIELD of STRONG MARLY SOIL (l.c. p. 494).

	Quantity sown.	Number of Seeds of each species of plant in the Quantity Sown.	Percentage of the Seeds of these Plants which usually Germinate.	Number of Seeds in the Quantity Sown which may be expected to Germinate.	Number of Seeds of the superior Grasses which should Grow.	Number of Seeds of the secondary Grasses which should Grow.	Number of Seeds of Rye-grass, Clover, &c., which should Grow.
	lbs.						
Meadow Foxtail	12	3,724,380	20	744,876	744,876	..	..
Cocksfoot	18	8,158,158	60	4,894,890	4,894,890	..	..
Hard Fescue	6	2,412,936	60	1,453,161	..	1,453,161	..
Meadow Fescue	12	2,802,360	60	1,681,416	1,681,416	..	..
Tall Fescue	6	1,221,180	60	840,708	840,708	..	..
Italian Rye-grass	24	7,044,264	90	6,339,834	..	..	6,339,834
Pacey's perennial Rye-grass	48	14,088,524	90	12,679,668	..	..	12,679,668
Crested Dogstail	6	4,114,650	60	2,468,790	..	2,468,790	..
Poa nemoralis	12	18,382,320	60	11,029,392	..	11,029,392	..
Poa trivialis	9	14,265,189	60	8,559,112	..	8,559,112	..
Timothy	9	7,316,559	90	6,584,901	6,584,901	..	..
Trefoil	12	7,878,132	100	7,878,132	..	..	7,878,132
Rib-grass	6	3,000,000	100	3,000,000	..	..	3,000,000
Cow-grass	18	5,400,000	100	5,400,000	..	..	5,400,000
White Clover	18	11,817,198	100	11,817,198	..	..	11,817,198
Alsike Clover	12	7,878,132	100	7,878,132	..	..	7,878,132
	228	119,503,982	..	93,250,210	14,746,791	23,510,455	54,992,964
In one acre there would be	38	19,917,330	..	15,541,201	2,457,798	3,918,409	9,165,494

He then tried inoculation, which seemed to succeed, and this he puts down to the superiority of the farming. I should consider it rather as due to his having used turf containing permanent grasses.

He then attempted to lay down pasture with sainfoin, and says "that as the sainfoin began to die out indigenous grasses began to make their appearance" (p. 437). Mr. Howard would have added not a little to the value of his article if he had informed us of the names of these grasses, so that we might judge of their value for stock. Further on he says, "I laid down land with lucerne, and from the beautiful carpet of green my field presents this spring I have every reason so far to be satisfied with the experiment." I have not seen Mr. Howard's newly formed pasture, but my experience would lead me to believe that the bulk of the grass which has sprung up with the lucerne is probably rough meadow grass and annual meadow grass or Suffolk grass (*Poa annua*), and if I am correct in my supposition, although good for stock at certain periods of the year when the lucerne dies, it will be found quite inadequate to form a pasture. My own experience coincides with that of Mr. Howard thus far, that where land can be sown down without a corn crop it is preferable. Mr. Howard seems to take it for granted that always after three or four years the grass must deteriorate, but here again he does not give us any information as to the species of grasses which disappear.

Among the most valuable contributions to the art of farming permanent pastures are the fifty-five reports in the 'Journal of the Royal Agricultural Society of England' of 1875 (Part II. vol. xi.), and the conclusions therefrom drawn by Messrs. Morgan Evans and T. Bowstead. But some of the results arrived at in these reports must be cautiously received. The reports support the assumption which, as I have already stated, has been put forward by seed merchants and farmers, and generally accepted, that in laying down pastures there must be a deterioration after the lapse of a few years; but it does not appear to me that the authors have taken account of the kind of seed sown, and so have not realised that the loss has been caused by the use of annual grasses and by the poor quality of the seed of the permanent grasses employed. Thus Mr. Morgan Evans writes (p. 501):—"There is little comment necessary on the mixture of seeds used by the various correspondents. These are of the usual kind recommended by seedsmen, and will vary according to their natural adaptation to the soil of the district. Timothy and alsike appear to be increasing in popularity. These, along with the fescues, white clover, rye-grass, &c., are the principal constituents." Thirty-six of the reports are from the North of England, and they testify that the experiments in laying down

pasture have been more successful in the North than in the South of England, from which the remaining nineteen reports come. It seems never to have occurred to one of the writers of these fifty-five reports that their want of success may have been due to the badness of the seed, or to the presence of a large proportion of annual grasses. The different size and weight of grass seeds make a very great difference in the number of seeds of particular species in a pound, but this has apparently been entirely overlooked. As an illustration, take the case of Mr. Robert Jefferson, who uses 700,000 seeds of meadow fescue and 620,000 seeds of meadow foxtail, as against upwards of 1,761,000 seeds of Italian rye-grass and the same number of perennial rye-grass. Let us suppose that the germinating power is equal in these four kinds of seeds, that is, that the same percentage produce plants ; we then arrive at the somewhat startling result that Mr. Jefferson's pasture contained more than five plants of rye-grass for each plant of meadow fescue, and a little less than six plants of rye-grass for each plant of foxtail. But this is an estimate too favourable to the two better pasture grasses, for the average germinating power of foxtail obtained from seed merchants cannot be taken at much over 20 per cent., while the rye-grass ranks at 90 per cent. And, still further, as this determination of the germinating power is obtained by careful experiment in the laboratory under favourable conditions, it must be remembered that the extremely delicate germinating seed of foxtail is more liable to suffer from the extremes of heat and cold which they may encounter in the field than the more robust seed of rye-grass. Neglecting, however, this probable cause of inequality in the plant-producing power of those seeds when sown in the open field, there yet remains the ascertained difference in the germinating power, which would give no less than twenty-eight plants of rye-grass to a single plant of foxtail in Mr. Jefferson's pastures.

Only seven of the reports give a detailed account of the seeds used, and in all these seven cases the proportion of rye-grass is large, and in some cases enormous, as, for example, No. 4, Mr. J. C. Bowstead (page 455), in which the rye-grass seed absolutely exceeds all the permanent grasses and clovers put together. No. 9 South of England, Mr. R. Caulcutt, who uses Sutton's and Wheeler's mixtures, says, "whoever lays down permanent pasture to any extent must make up his mind to lose for at least four or five years."—(P. 490.) Mr. Caulcutt would have supplied valuable information had he fenced off a small piece of the centre of the pasture sown with these mixtures, and at the time of the flowering of the grasses got a competent botanist to determine the names and proportions of grasses in the piece of

land so fenced off. By calculating the proportion of the plot thus fenced off to an acre, or to the whole field, he could have determined the proportion of good and bad grasses in his pastures, the real value per pound of the seeds purchased, and the extent to which the crop coincided with the seeds recommended in Mr. Martin Sutton's book. In all the pastures a large proportion of inferior grasses has been used, but a careful perusal of the reports makes it evident that the failures have been greatest where the proportion of these inferior grasses has been greatest.

The mixture employed by Mr. John Hemsley, 'Journal Royal Agri. Soc.' 1875, vol. xi. (page 476), approaches nearest to my idea of what such a mixture should be. He avoids the excessive quantity of perennial rye-grass, and leaves out entirely the Italian rye-grass.

Mr. Finlay Dun makes the following statement, which supports the conclusions at which I have arrived: "land long under grass always fouls, especially when rye-grass is with the clovers."—(l.c. p. 491). The dying out of the rye-grasses permits the growth of weeds which fill up the spaces left vacant, and this process takes place equally in perennial pastures as in grass laid down in alternate husbandry.

I give in the following Tables a detailed account of the number of seeds per acre used of each kind of grass and clover in all the mixtures mentioned by the different gentlemen, whose reports have given sufficient data to work upon, and it will be observed how persistently large quantities of rye-grass are used, and how very small the amounts of the four coarser and better grasses are.

I take it for granted that the lists of seeds in these reports, written by some of the best agriculturists in England, may be taken as a fair representation of their practice; many others, I fear, make no selection at all, but trust to seed-merchants to send what pleases them best.

It will be seen by comparing the number of permanent grass seeds given in the annexed tables (pp. 244–250) how far they fall short of the 40,000,000 individual plants which Sinclair ascertained to be the number in one acre of good established pasture.

From my examination of the principal works on the art of forming pastures, and of the trade pamphlets of the principal seed-merchants, it will be seen that none exclude rye-grass entirely from their mixtures, and that in no case is the universal failure of newly formed pastures, after the first year or two, ascribed to what I conceive to be its true cause; and as it is to this cause, and this cause only, that I attribute the failure of newly formed pastures, I will now endeavour to show how my own experience led me to arrive at this conclusion.

TABLE IV.—MIXTURE of SEEDS used by MR. JAMES C. BOWSTEAD (p. 455).

	Quantity Sown.	Number of Seeds of each Species of Plant in the Quantity Sown.	Percentage of the Seeds of those Plants which usually Germinate.	Number of Seeds in the Quantity Sown which may be expected to Germinate.	Number of Seeds of the superior Grasses which should Grow.	Number of Seeds of the secondary Grasses which should Grow.	Number of Seeds of Rye-Grass, Clover, &c., which should Grow.
	lbs.						
Cow-grass	4	1,200,000	100	1,200,000	..	..	1,200,000
White Clover	3	1,969,533	100	1,969,533	..	..	1,969,533
Red Clover	2	462,406	100	462,406	..	..	462,406
Trefoil	2	1,313,022	100	1,313,022	..	..	1,313,022
Timothy	3	2,438,853	90	2,194,967	2,194,967	..	..
Cocksfoot	3	1,359,693	60	815,815	815,815	..	..
Sheep's Fescue	2	807,312	60	485,387	..	485,387	..
Meadow Fescue	2	467,060	60	280,236	280,236	..	..
Smooth-Stalked Meadow-grass	2	3,170,042	60	1,902,025	..	1,902,025	..
Italian Rye-grass	31½	9,245,596	90	8,321,036	..	..	8,321,036
Perennial ditto	31½	9,245,596	90	8,321,036	..	..	8,321,036
Total	86	31,679,113	..	27,265,463	3,291,018	2,387,412	21,587,033

TABLE V.—MIXTURE of SEEDS used by MR. ROBERT JEFFERSON (p. 459).

	Quantity Sown.	Number of Seeds of each Species of Plant in the Quantity Sown.	Percentage of the Seeds of those Plants which usually Germinate.	Number of Seeds in the Quantity Sown which may be expected to Germinate.	Number of Seeds of the superior Grasses which should Grow.	Number of Seeds of the secondary Grasses which should Grow.	Number of Seeds of Rye-Grass, Clover, &c., which should Grow.
	lbs.						
Italian Rye-grass	6	1,761,066	90	1,584,959	..	..	1,584,959
Perennial Rye-grass	6	1,761,066	90	1,581,959	..	..	1,581,959
Cocksfoot	3	1,359,693	60	815,815	815,815	..	..
Timothy	2	1,625,902	90	1,463,311	1,463,311	..	..
Meadow Fescue	3	700,590	60	420,345	420,345	..	..
Various-leaved Fescue	1	403,656	60	242,193	..	242,193	..
Rough-Stalked Meadow-grass	2	3,170,042	60	1,902,025	..	1,902,025	..
Meadow Foxtail	2	620,730	20	124,146	124,146	..	..
Crested Dogstail	1	685,775	60	411,465	..	411,465	..
Ribgrass	1	500,000	..	..	..	..	500,000
Alsike Clover	5	3,282,555	100	3,282,555	..	..	3,282,555
White Clover	5	3,282,555	100	3,282,555	..	..	3,282,555
Cow-grass	3	900,000	100	900,000	..	..	900,000
Total	40	20,053,630	..	16,014,328	2,823,617	2,555,683	11,135,000

TABLE VI.—MIXTURE of SEEDS used by MR. JOHN OUTHWAITE (p. 461).

	Quantity Sown per Acre.	Number of Seeds of each Species of Plant in the Quantity Sown.	Percentage of the Seeds of those Plants which usually Germinate.	Number of Seeds in the Quantity Sown which may be expected to Germinate.	Number of Seeds of the superior Grasses which should Grow.	Number of Seeds of the secondary Grasses which should Grow.	Number of Seeds of Rye-Grass, Clover, &c., which should Grow.
	lbs.						
Meadow-grass	3	4,755,063	60	2,853,037	..	2,853,037	..
Evergreen Rye-grass	3	880,533	90	792,479	..	..	792,479
Fescue	5	1,167,650	60	750,590	750,590	..	..
Cocksfoot	$4\frac{1}{6}$	1,888,462	60	1,133,077	1,133,077	..	..
Pacey's Rye-grass	5	1,467,555	90	1,320,799	..	..	1,320,799
Italian Rye-grass	$4\frac{1}{6}$	1,222,962	90	1,100,665	..	..	1,100,665
White Clover	$4\frac{1}{6}$	2,735,462	100	2,735,462	..	..	2,735,462
Alsike	2	1,313,022	100	1,313,022	..	..	1,313,022
Cow-grass	2	600,000	100	600,000	..	..	600,000
Red Clover	1	231,203	100	231,203	..	..	231,203
Timothy	1	812,951	90	731,655	731,655	..	..
Total	$34\frac{1}{2}$	17,074,863	..	13,501,989	2,615,322	2,853,037	8,093,630

TABLE VII.—MIXTURE of SEEDS used by MR. JOHN SHUKER—FOR SHALY SOILS (p. 468).

	Quantity Sown per Acre.	Number of Seeds of each Species of Plant in the Quantity Sown.	Percentage of the Seeds of those Plants which usually Germinate.	Number of Seeds in the Quantity Sown which may be expected to Germinate.	Number of Seeds of the superior Grasses which should Grow.	Number of Seeds of the secondary Grasses which should Grow.	Number of Seeds of Rye-Grass, Clover, &c., which should Grow.
	lbs.						
Sweet Vernal	2	1,516,598	60	909,958	..	909,958	..
Crested Dogstail	3	2,057,325	60	1,234,395	..	1,234,395	..
Meadow Fescue	2	467,060	60	280,236	280,836	..	..
Cocksfoot	3	1,359,693	60	815,815	815,815	..	..
Sheep's Fescue	2	807,312	60	484,387	..	484,387	..
Tall Fescue	2	467,060	60	280,236	280,236	..	..
Rough-stalked Meadow-grass	2	2,170,042	60	1,902,025	..	1,902,025	..
White Clover	4	2,626,044	100	2,626,044	..	..	2,626,044
Alsike	2	1,313,022	100	1,313,022	..	..	1,313,022
Rib-grass	2	1,000,000	100	1,000,000	..	..	1,000,000
Perennial Rye-grass	8	2,348,088	90	2,113,279	..	..	2,113,279
Total	32	16,132,244	..	12,959,397	1,376,280	4,530,765	7,052,345

TABLE VIII.—MIXTURE of SEEDS used by MR. GEORGE CARTER (p. 470).

	Quantity Sown per Acre.	Number of Seeds of each Species of Plant in the Quantity Sown.	Percentage of the Seeds of those Plants which usually Germinate.	Number of Seeds in the Quantity Sown which may be expected to Germinate.	Number of Seeds of the superior Grasses which should Grow.	Number of Seeds of the secondary Grasses which should Grow.	Number of Seeds of Rye-Grass, Clover, &c., which should Grow.
Cocksfoot	lbs. $10\frac{1}{2}$	4,758,925	60	2,855,355	2,855,355	..	..
Foxtail	6	1,862,190	20	372,438	372,438	..	..
Pacey's Perennial Rye-grass	7	2,054,577	90	1,849,119	..	..	1,849,119
Meadow Fescue	$13\frac{1}{2}$	3,152,655	60	1,891,593	1,891,593	..	..
Sweet Vernal	$2\frac{1}{2}$	1,895,747	60	1,137,448	..	1,137,448	..
Smooth-stalked Meadow-grass	4	6,340,084	60	3,804,050	..	3,804,050	..
White Clover	3	1,969,533	100	1,969,533	..	..	1,969,533
Trefoil	2	1,313,022	100	1,313,022	..	..	1,313,022
Timothy	2	1,625,902	90	1,463,311	1,463,311	..	..
Cow-grass	$1\frac{1}{2}$	450,000	100	450,000	..	..	450,000
Total	52	25,422,635	..	17,105,869	6,582,697	4,941,498	5,581,674

TABLE IX.—MIXTURE of SEEDS used by MR. W. STEWARD (p. 480).

	Quantity Sown per Acre.	Number of Seeds of each Species of Plant in the Quantity Sown.	Percentage of the Seeds of those Plants which usually Germinate.	Number of Seeds in the Quantity Sown which may be expected to Germinate.	Number of Seeds of the superior Grasses which should Grow.	Number of Seeds of the secondary Grasses which should Grow.	Number of Seeds of Rye-Grass, Clover, &c., which should Grow.
	lbs.						
Perennial Rye-grass	15¾	4,622,798	90	4,160,518	..	..	4,160,518
White Clover	13	8,534,643	100	8,534,643	..	..	8,534,643
Trefoil	10	6,565,110	100	6,565,110	..	..	6,565,110
Alsike	4	2,626,044	100	2,626,044	..	..	2,626,044
Cow-grass	6	1,800,000	100	1,800,000	..	..	1,800,000
Red Clover	3	693,609	100	693,609	..	..	693,609
Crested Dogstail	1	685,775	60	411,465	..	411,465	..
Cocksfoot	1	453,231	60	271,938	271,938	..	..
Sweet Vernal	1	758,299	60	454,979	..	454,979	..
Meadow Foxtail	1	310,365	20	60,073	60,073	..	..
Hard Fescue	1	403,656	60	242,193	..	242,193	..
Smooth-stalked Meadow-grass	1	1,585,021	60	951,012	..	951,012	..
Total	57¾	29,038,551	..	26,771,584	332,011	2,059,649	24,379,924

TABLE X.—MIXTURE OF SEEDS used by MR. C. STEPHENSON (p. 487).

	Quantity Sown Per Acre.	Number of Seeds of each Species of Plant in the Quantity Sown.	Percentage of the Seeds of those Plants which usually Germinate.	Number of Seeds in the Quantity Sown which may be expected to Germinate.	Number of Seeds of the superior Grasses which should Grow.	Number of Seeds of the secondary Grasses which should Grow.	Number of Seeds of Rye-Grass, Clover, &c., which should Grow.
Perennial Rye-grass	lbs. $10\frac{1}{2}$	3,081,865	90	2,773,678	..	..	2,773,678
Cocksfoot	2	906,462	60	543,877	543,877	..	..
Timothy	2	1,625,902	90	1,463,311	1,463,311	..	..
White Clover	7	4,595,577	100	4,595,577	..	..	4,595,577
Red Clover	2	462,406	100	462,406	..	..	462,406
Total	$23\frac{1}{2}$	9,672,212	..	9,838,849	2,007,188	..	7,831,661

Nine years ago, circumstances led me to lay down to permanent pasture certain portions of land; and I did as most others have done, ordered the ordinary mixture for permanent pastures from one of the best seed-merchants. My first attempts were on a piece of arable land of six acres, and a piece of wood-land,—the underwood, after having been cut down, being fed off with sheep. The six acres I mowed twice the first year; the piece of wood-land could not be mown, and therefore was fed off with sheep.

I saw in the wood-land a grass I had not specially noticed before, and therefore got a book on grasses to find out the name, and found it was timothy, or catstail: this led to my finding out that there was a great difference in the feeding properties of the numerous grasses, and in my next attempt I ordered the grasses for myself, still ordering, as recommended by seed-merchants, a large quantity of strictly permanent rye-grass. This I watched carefully. When it came to flower and seed, the proportion of other grasses was so small, that the pasture might have been taken for rye-grass alone. I noticed in my pastures the deterioration, so much complained of by others, and was determined to find out the cause, and luckily for myself purchased Sinclair's book. I gradually learnt to know all the most valuable grasses in nearly all stages of their growth, and found that, however careful I was in my orders, and from whatever seed-merchant I ordered my seeds, the percentage of rye-grass, soft woolly grass, and other bad grasses and weeds, was beyond all belief. In order the more carefully to test the results, I fenced off a small portion of some of the newly-sown meadows. I found in a piece 8½ feet square about six plants of cocksfoot, one foxtail, two meadow fescue, five or six crested dogstail, and the rest rye-grass, soft woolly grass, perennial clovers, and weeds. I then got an introduction to Mr. Carruthers, and by means of his able help and valuable information, was enabled to make closer experiments. From these I learnt that good seed was most difficult to get; and to illustrate how difficult, I will give some of my experience. I had five acres of very valuable land I wished to sow with permanent grass for seed; the land was not only very good, but very highly manured, and absolutely clean, having been a hop-garden. I divided this field into three parts, one to be sown with cocksfoot, the second with meadow fescue, and the third with rough meadow grass. I ordered, with special care, the three kinds of seed from one of the great seed-merchants, and looked forward next year to a good crop of seed, not suspecting that when seed was especially ordered of a particular kind from a firm of repute, it would be anything but good. But after a few weeks' growth, although I was satisfied that the cocksfoot was true, my suspicions

were aroused about the others, and I sent some of the seed that was left to be examined by Mr. Carruthers. To my great amazement I was told that the meadow fescue was all rye-grass, and the rough meadow grass all smooth meadow grass. There was nothing left for it but in the best way possible to destroy all the grass, and resow it. The question might be fairly asked, Why not prosecute the firm for damages? The answer is this. Unless a purchaser of seeds suspects the seller, and has witnesses, it is difficult to prove the dishonesty. The seller may pay back a portion of the money charged for the seed rather than risk the exposure. It is not easy to make him pay consequential damages.

For my own instruction, and that of my friends, I divided a lot of four acres of clean poor land into five strips, and sowed foxtail, cocksfoot, catstail, crested dogstail, and meadow fescue separately in each strip; the foxtail was sown very thick, at the rate of 50 lbs. per acre, but only a few plants came up. The cocksfoot came up fairly; the catstail very well; the crested dogstail was a very thin plant, with four-fifths soft woolly grass, and the meadow fescue half rye-grass, while a piece of land left unsown grew no grass. I afterwards had the seed examined, and found only 35 per cent. of the crested dogstail good, and 20 per cent. of the foxtail. I have, since these experiments, never sown any seed except after the sample had been examined by Mr. Carruthers, and have, in consequence, obtained results most satisfactory to myself. By further experiments I have found that it is not sufficient to trust to having only the samples supplied by seedsmen examined, as they have been commonly better than the bulk; and also that it is not safe to have only some sacks of seed examined, but every single sack must be examined separately, and the seed taken from different parts of each sack; the sack ought then to be sealed and locked up, and an agreement made with the seed-merchant, that the seed is to be returned if the result of the examination is not sufficiently satisfactory. Many purchasers of seed no doubt may object to so much trouble, but I can assure them—and the results of Mr. Carruthers' experiments will corroborate what I say—that it is useless attempting to lay down land for permanent pastures unless the greatest care is taken with the seed. I regret to say that there is no seed-merchant I would trust sufficiently to use his seed without Mr. Carruthers' examination. These remarks may be thought too severe, but it must be remembered that this is my personal experience, and not only my experience on my own land, but on that of many others.

To make myself certain on this matter, I requested a friend to order the mixtures from four of the greatest seed-merchants in

England, and to take a fair example out of each and fasten them in a packet. These four I sent to Mr. Carruthers for examination, and the report was nearly the same in each case—a fair amount of seeds, the bulk consisting of so-called perennial and Italian rye-grass. I have no doubt that Mr. Carruthers will personally be able to explain the results of his examinations better than I can.

I had occasion this year to examine some newly-laid-down land in South Wales; and in two cases, although the mixtures were supplied by two of the best seed-merchants, the bulk was rye-grass.

On the estate of a gentleman in Kent, who had laid down upwards of 150 acres about thirteen years ago, there is hardly a good grass to be found, except a little cocksfoot and crested dogstail, probably blown by the wind, or dropped by birds.

A tenant of mine having purchased a permanent grass mixture from one of the large seedsmen, at a cost of 35*s.* per acre, mowed the land sown with the seed, and at my request Mr. Carruthers inspected the stack, and gave the following result of the examination of the hay, the clovers being excluded from the estimate:—

Cocksfoot	12	Woolly soft-grass	7
Meadow Fescue	2	Oats	3
Sweet Vernal	3	Barley	11
Crested Dogstail	8	Brome-grass	2
Rough Meadow-grass ..	6	Rye-grasses	941
Golden Oat-grass	4		—
Soft creeping-grass	2	Total ..	1005
Couch-grass	4		

If we exclude the oats and barley, together with the worthless grasses which may possibly have been in the ground, and treat the remaining individual grasses as if they were pounds, we have the following remarkable and instructive results: 35 lbs. of good grasses, at an average cost of 9*d.* per lb., would cost 1*l.* 6*s.* 3*d.*; and 941 lbs. of rye-grass, at 1½*d.* per lb., would come to 5*l.* 17*s.* 7*d.*; making a total of 7*l.* 3*s.* 10*d.* The 976 lbs. of mixed seeds for permanent pasture, at 9*d.* per lb., cost 36*l.* 12*s.*; making, on the data supplied by the hay, a difference of 29*l.* 9*s.* 1*d.* between the real value of the seeds and the price paid to the seedsman for the mixture. But this loss of nearly thirty pounds is nothing compared to the real loss when the consequential damage is taken into account.

The land from which this crop was taken having subsequently come into my own hands, I have sown a considerable quantity of good grass seed on it; but I have found in this case, as in others, where originally a large proportion of rye-grass

had been sown, it is very difficult to get other grasses to grow. I have come to the conclusion that rye-grass is certain to cause exhaustion to the soil, an opinion in which there are many to support me, although others, doubtless, are ready to dispute it.

Having arrived at the point of the necessity of eliminating rye-grass, it may fairly be asked how are we to get the good grasses. I have succeeded, after very much difficulty, in getting all grasses good by getting different grasses from different merchants, and when the seed was not sufficiently good to sow, leaving it and trusting to next year; but where it was only inferior in germinating power, I have sown an extra quantity to make up for want of this quality.

The best means of laying land down to permanent pasture has been fully and carefully entered into by Mr. Evershed in his valuable paper read at the Farmers' Club. This ought to be carefully studied by all who intend laying down land to pasture. I have myself laid land down in almost every tilth, but, where the seed has been good, I could never see much difference in the results, except such as were accounted for by the richness or poverty of the soil. Where the land was in good heart and rich, the grass grew strong and better, and where it was poor and out of heart, it grew weaker, but in both cases the grass was there. Unquestionably the better condition the land is in, the stronger the grass will be. It must be decided what amount of money a person can afford, and whether he can prepare the ground expensively or not. I have arrived at the best results by sowing the grass seeds with rape and mustard, and feeding them off together with lambs highly fed with artificial food. I should strongly advise all who have really valuable land, and not too wet, to lay it down in this way. On the other hand, if the land is of very inferior quality, it might hardly pay for expensive cultivation, and in that case it would be best to sow it with a thin crop of corn, and after the grass had got fully established in the following summer, to let sheep run over it fed with food of high manurial value.

The different habits and peculiarities of the best permanent grasses have not been sufficiently studied, and consequently many of our best pastures are deteriorating year by year without the owners being aware of it. The flower-heads of all the best permanent grasses are much liked and greedily eaten by stock; consequently they never come to seed unless very thinly stocked indeed, or a crop of hay is cut very late, whereas, on the other hand, the flower-heads of the worthless grasses which are disliked by stock are continually and constantly seeding, such as the brome grasses, the soft woolly grass (*Holcus lanatus*), creeping rooted soft grass (*H. mollis*), barley grass (*Hordeum pratense*),

rye-grass, crested dogstail, and hard fescue. These grasses generally compose too great a proportion of the meadow pasture from this fact, that stock do not eat their flower-heads, so that they ripen and cast their seeds.

Another cause of the pasture deteriorating is that stock, sheep especially, have a great partiality for some grasses over others. I have watched carefully the procedure of well-fed sheep when they were grazing. In the progress of my investigations I observed that the rams were more particular in the rejection or selection of the different elements in the pasture, and I accordingly directed my attention specially to their behaviour. By the aid of an opera-glass I have been able to make these observations without disturbing the sheep: I have been surprised at the way in which they discriminate between two grasses, eating the leaves of the one and rejecting those of the other, though they are closely intermingled as they grow. The better grasses are consequently cropped closely. It necessarily follows that the grasses that are rarely cropped will, from the natural sowing of their ripe seeds, in the course of two or three years, greatly increase, although they may not entirely exterminate the better ones.

The great number of inferior meadows in England are due to these two causes; and the only way, in forming a new pasture to secure satisfactory results, is to sow only good grasses, which the stock will eat, and to select such different kinds as will supply stock with food as the seasons come round. Nature has provided a succession of nutritious grasses, which follow each other with wonderful regularity in our temperate climate, and throughout the whole spring, summer, and autumn there should always be a grass in perfection in every good pasture.

I have frequently seen it stated that, while stock may do well in a pasture at one period of the year, they fall off at another, however favourable the season may be. In some meadows sheep do remarkably well in the spring, in others in summer, and in others again late in the autumn. I have invariably been able to trace the cause to the kind of grass forming the pasture, and have found no explanation for it either in the soil or the configuration of the land. A meadow composed of a large percentage of foxtail is certain to produce a large quantity of early keep. The deep-green coloured leaves of this grass may be observed some inches long before other grasses have begun to grow. Foxtail, therefore, ought to be a grass for early lambs on all soils where it will grow. Unfortunately, the flower-heads of foxtail are so greedily eaten by stock that it rarely or never has a chance of seeding in any meadow to which stock have access; it is, however, the earliest of all grasses to seed, and therefore usually sheds its seed before hay is cut. The crested dogstail is

a remarkable contrast to this grass. Wherever the dogstail abounds, which it frequently does, in too large a proportion, the complaint will be heard that it does not do to lamb early, as the land will not yield early grass. It will also be found that, where stock fatten admirably, chiefly on this grass, about midsummer, they rapidly fall off if left in the pasture after the dogstail is ripe. Crested dogstail differs from foxtail not only in being later, but also in being a much smaller grass. Besides, its flower-heads are rarely or ever eaten by stock until the seed is fully ripe, so that it steadily and continually increases both by seed and root. The habits of hard fescue and sheep's fescue are almost identical with those of crested dogstail. It must therefore be evident that these three grasses, although useful, should be sown in much less quantities than the larger or coarser grasses—meadow fescue, cocksfoot, and catstail, the flowers of which are greedily devoured by the stock in the same way as foxtail.

Cocksfoot is by far the most valuable of all grasses because it grows in all soils ; it produces the greatest amount of keep ; it is the most nutritious grass, and seems to grow faster and stronger in extremes of weather, either wet or dry, than any other grass. There is, moreover, hardly any stage of its growth in which stock do not eat it greedily, and its flower-heads appear to me to be especially nutritious to all kinds of stock, young or old, in excessively wet weather. Cocksfoot has no chance of seeding, unless there is a great abundance of it and the stock are running light. Cocksfoot is often objected to, as it is said that stock pull it up by the roots ; but it will be observed that it is not the centre root, but the side shoots that are lying on the ground, cocksfoot being different from the other permanent grasses in its growth ; it also shoots quicker than any other permanent grass after having been mown, and its long leaves may be invariably observed wherever it is present in a meadow after it has been mown for hay. On this account it is extremely objectionable in lawns.

Timothy or catstail commences to grow about as early as cocksfoot in the spring, and bears feeding off remarkably well, as it seems to produce as heavy a crop in summer after having been fed off in the early part of May, as it would have done had it not been so fed off ; it is, like cocksfoot, never allowed to seed by stock, and its flower-heads are extremely grateful, when the seed is ripe, to both young or old stock. This grass is much objected to by many on account of its apparent coarseness, but as all kinds of stock like it, there is no force in this objection. The aftermath of this grass does not appear so strong in growth as that of either foxtail or cocksfoot.

Meadow fescue is another grass that in all stages of its growth is liked by stock. Tall fescue is much the same in habit as meadow fescue, but larger in growth, and is said to succeed on very wet heavy soils better than most grasses. The results of recent observations have led me to give a much higher value to this grass than is generally ascribed to it.

The poas are a numerous genus, the most valuable of which is rough meadow grass, a useful kind when mixed with others; but I consider it of second-rate quality, because, as far as my observation goes, it only grows well in years very favourable to the growth of all grasses, and when there is consequently an abundance of others superior to it. The *Poa annua* (annual meadow grass) is a small annual grass, a troublesome weed in roads; it seems to spring spontaneously in all rich soils, especially on a footpath, or any place which is much trodden; it grows all the winter when it is not freezing. Stock eat it greedily, and therefore I consider it should not be objected to in pastures. It is scarcely within the scope of this paper to say anything about the other grasses of this genus.

Golden oat-grass (*Avena flavescens*) is found frequently in good pastures. I once sowed it largely, but I have noticed that sheep eat all the superior grasses in preference. I therefore do not now sow this grass except on dry banks. Sheep's fescue is highly spoken of by many, but I have never known it eaten when sheep could get the better grasses; but perhaps it is well to sow a little, especially on dry banks.

Fiorin is perhaps the best known of all grasses, and, from its great resemblance to water-grass or couch of some countries, is looked upon as a troublesome weed by many. It affords an early and late bite when other grasses are scarce, and is therefore one of the valuable constituents of pastures.

In addition to these a small quantity of the four clovers, viz., alsike, cow-grass, perennial red clover, and Dutch clover, ought to be sown. Alsike is said to do better than other clovers, where the land has been growing clover before and is what is termed clover sick. It is usual to sow far too large a proportion of clovers in relation to the true grasses; for while sheep may have too much clover they cannot have too much grass. Clovers also are not so early as the better grasses, and are not such valuable feeding in the autumn, and grow only a little, if anything, in the winter, wherefore clovers only afford food in the height of summer, when there is an abundance of grass.

Yarrow (*Achillea*) is a herb that sheep especially like, and however great may be the quantity in a pasture, it is rare to see it in blossom where sheep are; cattle have not such a predilection

for it as sheep, but before the autumn comes it will be found closely eaten.

Plantain (*Plantago lanceolata*) is recommended by many people, but I never could see that it is anything but an encumbrance.

My experience leads me to think that the plants favourably noticed above are those best fitted for forming permanent pasture. The quantity of seeds to be sown requires only to be varied according to the soil and requirements of each case; if the pastures already formed contain the later grasses, then a larger proportion of the earlier grasses may be used in the newly-formed pasture.

By careful feeding, the growth of particular grasses may be encouraged, because although these better grasses are liked by sheep, yet sheep have a preference for each at particular periods of the year, varying according to the season; and those who study carefully the habits of grasses can, by shifting the sheep and by not stocking the ground too hard, allow any grass to seed. This remark refers only to meadows composed solely of good grasses; for in meadows where there is an abundance of bad grasses, sheep prefer the better kinds, even when they are not in perfection, to the bad grasses when they are in perfection.

There are two other grasses which can hardly be classed as bad or good, and which are probably found in sufficient quantities amongst seed without especially sowing. These are sweet vernal (*Anthoxanthum odoratum*) and tall oat-grass (*Holcus avenaceus*); the former of these grasses is strongly aromatic in smell and taste; the latter extremely bitter. Should any one wish to be convinced how great the difference is among grasses, he should satisfy himself by tasting these two grasses and cocksfoot, and if he can readily discriminate between the three, it is easy to conceive the difference there must be to herbivorous animals like sheep.

Barley-grass (*Hordeum pratense*) is another grass that requires a passing notice. From its frequency in valuable pastures, and from its easily recognised habit, it has gained a reputation it does not deserve, for although its leaves have valuable properties, the seed-heads are covered with sharp horns, which render it dangerous to sheep and very objectionable in hay. This grass grows also on chalky banks, but on such soils it seems useless.

To lay down to permanent pasture it is necessary to get good seed of the kinds recommended. The results will then be more or less good in accordance with the richness of the land and the amount of stimulating food that is given to the sheep that feed on it, or the amount of manure that is put on it; the richer the land and the more highly farmed the more evident the grasses will be, but once established, the permanent grasses will not disappear.

My experience leads me to believe that more highly farmed pastures pay best; but circumstances may make it necessary that large breadths of land should be laid down in every imaginable tilth. There is hardly any tilth in which I have not sown grass, and I have at present a very satisfactory pasture three years old, sown with oats after wheat, following clover which followed wheat.

I object strongly to mowing young grass, and I like, if possible, to allow certain portions of the grass to seed. When the grasses are all good it matters not how long the grass is allowed to grow, it will have no deleterious effect upon the stock, and is certain, sooner or later, to be eaten close. On the other hand, in meadows where *Holcus lanatus*, or soft woolly grass, or sorrel is prevalent, if the sheep are compelled by hunger to eat these grasses and weeds they are almost certain to be attacked with diarrhœa, especially in the case of young or delicate stock.

I do not propose to enter into the details of farming stock on grass, or into the comparative values of grass and arable land; but my impression, judging from the results I have seen in orchards in Kent, is that, if grass lands were farmed with the care and judgment bestowed on arable land, the results derived from pasture farming would be very different from what they are at present. The comparatively low price at which feeding stuffs and corn can be purchased ought to tend to their use on pastures in winter.

Inasmuch as we can now, by the use of creosote, make almost imperishable fences of very inferior wood, it materially lessens a great item in the cost of forming pastures; as where there are no hedges, other fences must be taken into consideration. I use creosote also for the feeding troughs, and find that the sheep eat from these as readily as from the uncreosoted troughs.

Among the many arguments that I have heard urged against pastures, it is often stated that, if stock are fed very high and make the ground very rich, the land becomes very foul. This is directly opposed to my experience, as I have noticed that when the ground is rich, the grass good, and the stock highly fed, the meadow is not so much covered with the excrement of the animals as where the land is poor and the grass of bad quality. That is to say, a rich piece of pasture, with six, or even more, sheep per acre upon it, would be cleaner than a poor piece of pasture with three sheep an acre.

I wish again to notice the late Mr. Carrington's new pastures because of his success in forming them with, or, as I would say, notwithstanding, his admixture of very considerable quantities of rye-grass and rib-grass. His pastures go far to prove that by means of an unlimited outlay in artificial and other

manures, a small quantity of good seeds may not only be maintained, notwithstanding the deterioration of the soil by rye-grass, but may even be so strengthened and nourished as to gain in size and to tiller out and multiply to an extent sufficient to cover the ground previously occupied by the rye-grass or other temporary plants which, at the end of three or four years, have died out. In all other respects this expensive course of manuring is neither desirable nor convenient. It is not necessary for the purpose of this article to deny that by extravagant manuring good pastures may in course of time be formed, although a mixtrue including rye-grass or other injurious grasses be sown,—but rather to demonstrate how permanent pastures of the best possible description can be formed economically, and with a certainty that they will not die out, or deteriorate at the end of four or five years, or at any future time when the heavy manuring is discontinued. The expense of getting the land into good heart, the addition of a liberal, but not an extravagant, supply of manure, and, above all, the sowing of an adequate supply of good seeds of the right kinds, will incontestably save infinite expense, loss, and disappointment in the future.

It may be well before closing to give the following summary of the principal points which my experience has led me in the main to adopt, for the laying down of the best permanent pastures on any fairly good and suitable lands.

The preparation of the land is not in my opinion of prime importance. The cultivator must nevertheless keep in view that the richer the land so much the better will the grass grow.

I hold that the main point to be attended to is the employment of the best seeds. All seeds should be tested by a competent botanist, with the view of determining whether they are really the kind ordered, are free from weeds, and such dangerous ingredients as ergot, dodder, &c.; and whether they have sufficient germinating power to justify their being sown.

My experience would lead me to employ the mixtures stated in the following tables. I have specified the number of seeds that these mixtures contain per acre. If all these seeds were to produce plants, the first growth would still be only half of the number that Sinclair has estimated as existing in established pastures. But my belief is that the cost of employing a sufficient quantity of seed to produce the 40,000,000 plants in an acre would be too great to make it possible to use them. And yet more important is the consideration that not only greater economy but greater certainty as to the results will be obtained if the good grasses are allowed partially to seed and sow themselves. A good thick pasture can in this way be secured at a comparatively small cost.

MIXTURE of SEEDS for GOOD or MEDIUM SOILS.

	Number of lbs. per Acre.	Price per lb.	Total Cost.	Number of Seeds in the entire quantity.	Per Cent. of Germinating Power.	Total Number of Germinating Seeds in the entire quantity.	Quantity required to make the Number of Germinating Seeds equal to the Number of Seeds required.	Total Cost of the same.	Total Number of Germinating Seeds.
		s. d.	£ s. d.				lbs.	£ s. d.	
Foxtail	10	1 1¾	0 11 5½	3,103,650	20	620,730	50	2 17 3½	3,103,650
Cocksfoot	7	0 9	0 5 3	3,172,617	60	1,903,568	11⅔	0 8 9	3,172,617
Catstail	3	0 6½	0 1 7½	2,438,853	90	2,194,967	3⅓	0 1 9½	2,438,853
Meadow Fescue	6	0 9	0 4 6	1,401,180	60	840,708	10	0 7 6	1,401,180
Tall Fescue	3	0 9	0 2 3	700,590	60	420,354	5	0 3 9	700,590
Crested Dogstail	2	2 0	0 4 0	1,371,550	60	820,930	3⅓	0 6 8	1,371,550
Rough Meadow Grass ..	1½	0 10	0 1 3	2,377,530	60	1,426,519	2½	0 2 1	2,377,530
Hard Fescue	1	0 6	0 0 6	403,656	60	242,193	1⅔	0 0 10	403,656
Sheep's Fescue	1	0 10	0 0 10	403,656	60	242,193	1⅔	0 1 4½	403,656
Fiorin	1½	0 10	0 1 3	4,382,446	60	2,629,467	2½	0 2 1	4,382,446
Yarrow	1	3 0	0 3 0	3,500,000	40	1,400,000	2½	0 7 6	3,500,000
Perennial Red Clover	1	1 0	0 1 0	231,203	100	231,203	1	0 1 0	231,203
Cow Grass	1	1 2	0 1 2	300,000	100	300,000	1	0 1 2	300,000
Alsike	1	0 11	0 0 11	656,511	100	656,511	1	0 0 11	656,511
Dutch Clover	1	0 11	0 0 11	656,511	100	656,511	1	0 0 11	656,511
	41	..	1 19 11	25,099,953	..	14,585,854	98⅙	5 3 7½	25,099,953

Mixture of Seeds for Wet Soils.

	Number of lbs. per Acre.	Price per lb.		Total Cost.			Number of Seeds in the entire quantity.	Average Germinating Power per Cent.	Number of Seeds which may be expected to Germinate.	Number of lbs. required to make the Germinating Power 100 per Cent.	Cost of this Quantity.			Total Number of Germinating Seeds.
		s.	d.	£	s.	d.					£	s.	d.	
Foxtail	4	1	1¾	0	4	7	1,241,460	20	248,292	20	1	2	11	1,241,460
Cocksfoot	10	0	9	0	7	6	4,532,310	60	2,719,385	16⅔	0	12	6	4,532,310
Catstail	3	0	6½	0	1	7½	2,438,853	90	2,194,967	3⅓	0	1	9¾	2,438,853
Meadow Fescue	3	0	9	0	2	3	700,590	60	420,345	5	0	3	9	700,590
Tall Fescue	8	0	9	0	6	0	1,868,240	60	1,120,944	13⅓	0	10	0	1,868,240
Crested Dogstail	2	2	0	0	4	0	1,371,550	60	822,930	3⅓	0	6	8	1,371,550
Rough Meadow Grass ..	2	0	10	0	1	8	3,170,042	60	1,902,025	3⅓	0	2	9¼	3,170,042
Hard Fescue	1	0	6	0	0	6	430,656	60	242,193	1⅔	0	0	10	430,656
Fiorin	2	0	10	0	1	8	5,843,262	60	3,505,956	3⅓	0	2	9¼	5,843,262
Yarrow	1	3	0	0	3	0	3,500,000	40	1,400,000	2½	0	7	6	3,500,000
Perennial Red Clover ..	1	1	0	0	1	0	231,203	100	231,203	1	0	1	0	231,203
Cow Grass	1	1	2	0	1	2	300,000	100	300,000	1	0	1	2	300,000
Alsike	1	0	11	0	0	11	656,511	100	656,511	1	0	0	11	656,511
Dutch Clover	1	0	11	0	0	11	656,511	100	656,511	1	0	0	11	656,511
	40	..		1	17	9½	26,931,198	..	15,421,262	76½	3	15	5¼	26,931,198

MIXTURE of SEEDS for CHALKY SOILS.

	Number of lbs. per Acre.	Price per lb.	Total Cost.	Number of Seeds in the entire quantity.	Average Germinating Power per Cent.	Number of Seeds which may be expected to Germinate.	Number of lbs. required to make the Germinating Power equal to 100 per Cent.	Total Cost of the same.	Total Number of the Germinating Seeds.
		s. d.	£ s. d.					£ s. d.	
Cocksfoot	14	0 9	0 10 6	6,345,234	60	3,807,132	23⅓	0 17 6	6,345,234
Catstail	3	0 6½	0 1 7½	2,438,853	90	2,194,967	3⅓	0 1 9¾	2,438,853
Meadow Fescue	2	0 6	0 1 0	467,060	60	280,236	3⅓	0 1 8	467,060
Crested Dogstail	5	2 0	0 10 0	3,428,875	60	2,057,325	8⅓	0 16 8	3,428,875
Hard Fescue	4	0 6	0 2 0	1,614,624	60	968,772	6⅔	0 3 4	1,614,624
Sheep's Fescue	4	0 10	0 3 4	1,614,624	60	968,772	6⅔	0 5 6¾	1,614,624
Yarrow	2	3 0	0 6 0	7,000,000	40	2,800,000	5	0 10 0	7,000,000
Golden Oat Grass	1	0 9	0 0 9	200,000	60	120,000	1⅔	0 1 3	200,000
Perennial Red Clover ..	1	1 0	0 1 0	231,203	100	231,203	1	0 1 0	231,203
Alsike	1	0 11	0 0 11	656,511	100	656,511	1	0 0 11	656,511
Dutch Clover	1	0 11	0 0 11	656,511	100	656,511	1	0 0 11	656,511
	38	..	1 18 0½	24,653,495	..	14,741,429	61⅓	3 0 7½	24,653,495

Should I receive seeds possessing qualities that induce me to use them, but with germinating power lower than the average, I increase the quantity per acre in proportion to the ascertained deficiency; thus, if only 20 per cent. germinates in a seed which should give an average of 60 per cent., I would employ three pounds instead of one.

I feel satisfied that, speaking generally, if the principles which I advocate and have practised are adopted, farmers will not encounter the disappointment which has been so universally experienced in laying down pastures, though the absence of annual plants will necessarily deprive the pastures of that verdant and vigorous growth in their first stages, so much desired by seed merchants, and so misleading to the public.

In conclusion, I desire to add that it is far from my thoughts to imply that I have as yet learned all that I hope for on this very important and interesting subject; but I am firmly convinced that in deciding never to sow for permanent grass any but the purest seeds obtainable of the best permanent grasses, I have taken an important step in the right direction. Could I have done this at the outset I should have gained an incalculable amount of valuable time, and saved myself from the fruitless, I may say mischievous, expenditure of no inconsiderable amount of money.

X. *Report on the Exhibition and Trials of String Binders at Derby.* By J. COLEMAN, Riccall Hall, York.

THE determination of the Council of the Society to offer a Gold Medal for the best binder with material other than wire, whether attached to a reaper or separate, brought to the Show at Derby a large entry, and added not a little to the interest of that successful Meeting. Great credit is due to the Society for having, whilst fully recognising the merit of the American wire-binders, stimulated invention in a direction more practically useful to the English farmer; it having been realised from the first that wire could not be employed with safety in this country. And it is a fact worthy of mention that the enterprise thus fostered and encouraged, with a view to our own requirments, has been to a large extent adopted in America, where the output of one firm alone has for one year exceeded 10,000 separate machines. Before entering into details, it is only bare justice to American inventors to state that the most successful String-binders were of American origin, and that they have so far proved very decidedly

in advance of English invention. No doubt the fact of American machinists having been at work so long on binding mechanism was greatly in their favour. There was very considerable merit in the invention of Mr. H. J. H. King, which appeared in more than one form, but in neither his own nor Bamlett's case were the details sufficiently perfected for absolute success. The efforts of the Society to stimulate invention in the direction of a Gleaner which should pick up the corn as left by either a sheafing or swathing machine were not so successful, as though three or four such machines were exhibited, the only one that was put to work failed to effect its object. That such failure was due to imperfection in mechanical details, rather than to insuperable difficulties, may be judged of from the fact that when tried in the Showyard the sheaf was picked up and bound. It is to be hoped that the offer of a prize for such a machine will be continued, as under many conditions separate operations of cutting and binding are preferable. Wherever the climate admits of the early cutting of corn, *i.e.* before it has become ripe, or in districts which are forward, and especially in the case of corn containing much clover and grass-seeds, or other more objectionable material, it is most desirable that the same should become withered as rapidly as possible, which must be extremely difficult when it is tightly tied up as soon as cut. As no gleaner or binder was worked at the trials, the one machine that was present being unable to operate, no comparison of results was possible. I have a report from Mr. Richard Hall, of Thulston, on whose farm most of the work was done. When it is borne in mind that the weather was showery, and that much of the corn was cut in a somewhat damp condition, Mr. Hall's evidence as to the effect of tight binding is important. He says: "Contrary to expectation, I was pleased with the tight binding of the corn cut on my farm by the binders, especially so with the barley, of which I was most afraid (it being so far from ripe), but the tight binding and accurate packing prevented access of rain-water, which ran off the sheaves as it would do from thatch. The wheat, though damp when it was cut, took very little damage from the binding; in fact had it been tied less tightly a considerable portion would have slipped out of the binding. The oats, being so very ripe, did not bind together like the barley and wheat, and consequently suffered more damage from the excessive wet. From this you will gather that I am in favour of cutting rather green. The facts as to the barley afford stronger evidence of the correctness of my views. The remainder of the field was left standing for three weeks, and yielded a very inferior quality. Of course the last harvest was extraordinary and exceptional. With fine

dry weather the gleaner and binder might allow of earlier harvesting; but some risk attends leaving corn on the ground, and when once well tied and carefully stooked, most corn will stand a lot of rain without injury. As regards barley full of clover, this is awkward to deal with in bad weather; but I prefer having the corn as far from the ground as possible, as I find it takes less damage, especially if three or four sheaves are set up together. As you know, some of the barley was cut not merely damp but very wet. This is not considered in the general meaning of what I have said. My remarks refer to that corn cut rather green and damp."

The following machines were entered for trial and exhibited in the Showyard at Derby:—

Combined Reapers and Binders.

Catalogue No.	
4183	Johnston Harvester Company.
4325	George Kearsley.
4380	A. C. Bamlett.
4395	D. M. Osborne and Co.
4400	McCormick Harvesting Machine Company.
4404	Hetherington and Co.
4412	J. and F. Howard.
4489 } 4491 }	Samuelson and Co.
4547	C. Aultman and Co.
4554	H. J. H. King.
4556	Walter A. Wood.
5267	Hornsby and Sons.

Gleaners and Binders.

4184	Johnston Harvester Company.
4546	G. Spencer.
4550	Notts Fork and Implement Company.

The formidable list of Combined machines is reducible into much smaller limits, seeing that several makers adopted the same principle; thus, McCormick's, Johnston's, and Samuelson's machines were identical in construction, and only differed in such trifling details that the description of any one machine will suffice. Again, Bamlett, Hetherington, and King work from the same patents; and one detailed and illustrated description, that of H. J. King's invention, the only one of the three brought to trial, will suffice. Mr. Walter A. Wood's machine, unique in its construction, demands detailed notice. Messrs. Howard's and Aultman's inventions, as the only others which came to trial, require some attention; and a brief reference to the exhibits of Messrs. Hornsby and Co., and of Kearsley, will conclude the notes made in the Showyard on the Combined machines.

As regards the Gleaners and Binders, a description is appended of the Notts Fork and Implement Company's invention, and the Johnston Harvester Company's machine, which appeared the most deserving of notice.

McCormick and Co.'s Twine-binder is identical in tying and packing mechanism with the machines shown by The Johnston Harvester Company, and Samuelson and Co., inasmuch as they all adopt what was originally Appleby's patent, but which is now public property in England, therefore one description will suffice; and as the McCormick machine was awarded the Gold Medal as the most successful machine at the trials, it is only right that it should be carefully described. The binding mechanism is attached to an ordinary American harvester, with travelling platform, elevator, &c. The first motion is by a spur-wheel on the main axle, 24 inches diameter, which drives a pinion on countershaft No. 1, which on its opposite end carries a bevel wheel sliding on a feather, and actuated by a clutch under the control of the driver. This bevel wheel drives a bevel pinion on shaft No. 2, running backwards and parallel to the main driving wheel: on its rear end is a triple wheel, comprising a small chain wheel, which drives the binding-gear, a spur-wheel to drive the bottom apron through an intermediate wheel, and a larger chain wheel for the elevator, on the other side of which is the pitman crank, working the knife from behind. The binding mechanism comprises first, a shaft (No. 3), which runs from back to front of the machine under the binding-table. On its forward end is a small chain wheel, driving on to a square shaft No. 4, with a loose chain-wheel on it, so as to adapt its position to the table when the latter is shifted. On the rear end are two cranks, actuating the packers, which sink through slots on the binding-table. On the foremost end of No. 4 shaft is a small geared pinion, also loose, with a stop pivoted to it, which is held by a paul actuated by the compressor. On the extreme end of the shaft, beyond the stop, is a clutch with two driving-prongs, which engage into the tail of the stop when the paul is out of gear. When the paul comes into gear with the stop, the tail of the latter is so depressed as to allow the clutch to clear it, and so the pinion is thrown out of gear.

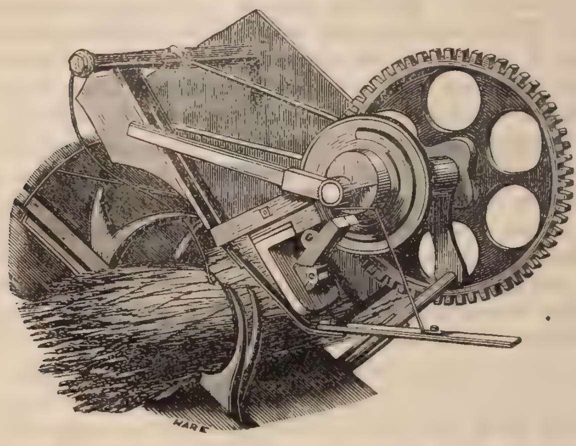
This pinion, through two intermediate wheels, drives the knotting-gear, by means of a large spur-wheel on the binder-shaft No. 5, with cams on both sides; that on the outside works a tension lever for the string.

A crank-pin on the outside cam actuates a crank and rocking-shaft, the opposite end of which carries the needle arm.

The compressor is pivoted on a crank at the back of the needle arm; and it actuates first a rocking-shaft, with a cam which locks

the paul which holds the driving pinion on No. 4 shaft already described; and secondly, the lever of a rocking-shaft, the opposite end of which has a crank connected by a spring rod to a cam roller on the inside of the large cam-wheel on shaft No. 5; the object being first to compress the sheaf at the moment of its being tied, and then to depress the compressor after the string is cut, to allow of the sheaf being discharged. The crank to which the compressor is attached has also two light discharge arms which serve to depress the hinged tail-boards of the platform, which are fixed at an angle during the collection and formation of the sheaf, as to prevent any scatter of straw, &c.

Fig. 1.



The large tyer cam-wheel which is so well seen in the illustration is keyed on the shaft No. 5, which goes half across the table and drives the knotting gear. The operations to be performed comprise—

1. Holding the free end of the string.
2. The action of the needle-arm and the supply of string.
3. The making of the knot.
4. Cutting the string.
5. Discharging the sheaf.

(1.) On shaft No. 5, near its centre, is a cam-wheel, which actuates a plunging bolt, kept against it by a volute spring. In the event of an accident to this spring, the same action is secured by a central plunger cam on the end of the shaft No. 5.

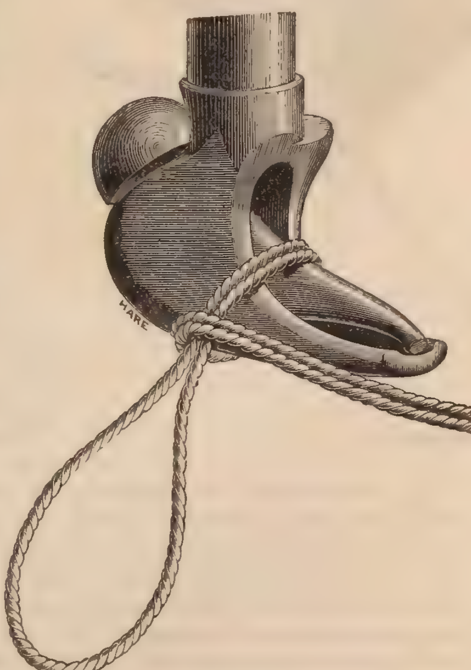
The plunger bolt works through eyes attached to the knotter frame, and supports a loose rocking frame carrying the twine-holding disc. This disc is about 2½ inches in diameter, and

has six smooth-edged recesses, into any one of which the string is guided. One edge of this disc works closely between cheeks, between which and itself, by its revolution, it carries and jambs the string, and so holds the free end. The rotary motion is communicated by the plunger bolt, lever and paul and ratchet, with a spring catch on the opposite side to prevent it from turning backwards, and so liberating the string.

(2.) The string, which is fed from a tin canister on the top of the machine, through a tension regulating and taking up slack apparatus, passes through guide-eyes and tubes to the side of the needle-arm and along the needle for about one-third of its length, without roller or springs.

(3.) The knotter is of the bird-beak type, and made under Appleby's patent. The lower half of the beak or jaw has simply a revolving motion. The upper beak can be opened by a cam surface, and closed by a spring cam actuating a small roller on the back end of the beak.

Fig. 2.



The motion for making a knot consists of one complete revolution in one direction only, and is obtained by a short toothed segment on the cam-wheel on shaft No. 5. Both strands of the string pass over both beaks, as seen in Fig. 1, and are prevented from getting out of place by a tucker, consisting of a lever actuated by a cam or cam-wheel, and which follows the string as soon as the needle has passed over the beaks; and without actual contact, it effectually prevents the string getting out of place. At the proper moment for making the knot, the beaks revolve, forming the loop, as shown in Fig. 2. Then the upper beak

opens, engages both strings, nips them tight (see Figs. 3 and 4), and at this moment the knife-arm pushes the loop over the portion held by the beak, thus making the knot.

(4.) The knife is fixed to the lower side of the knife-arm, which is pivoted to the knotter frame, and actuated by an inner cam on the cam-wheel on shaft No. 5. It does not actually cut against anything, but it works within a quarter of an inch of a fixed guide which offers the necessary resistance.

Fig. 3.

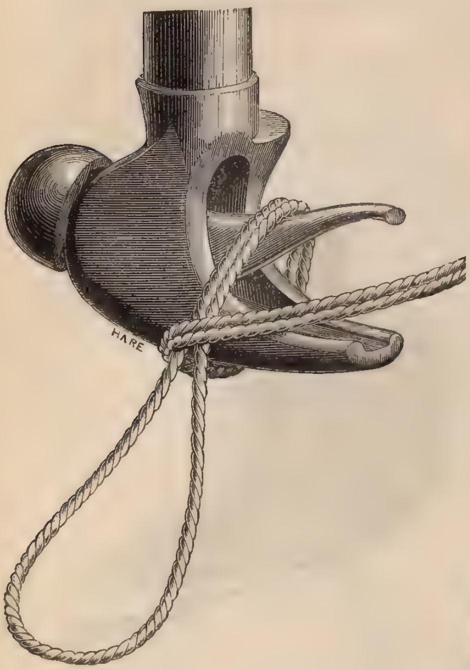
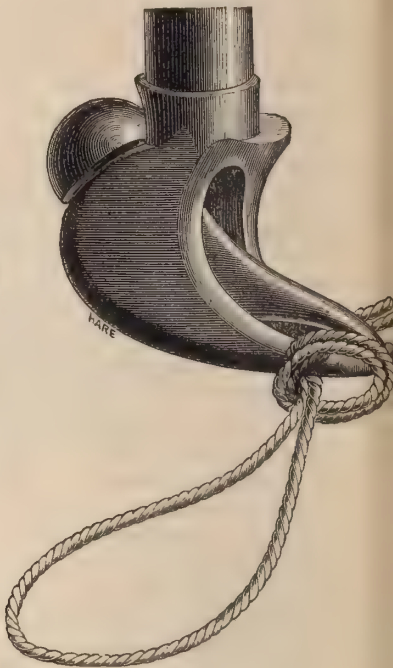


Fig. 4.



(5.) The sheaf is discharged by the action of the light arms, which are seen in the first illustration. These arms are keyed on the knotter shaft, about a foot apart, on either side of the cam-wheel and gear. Their action is simply to push off the sheaf as the shaft revolves, the hinged platform and compressor arm dropping at the same moment.

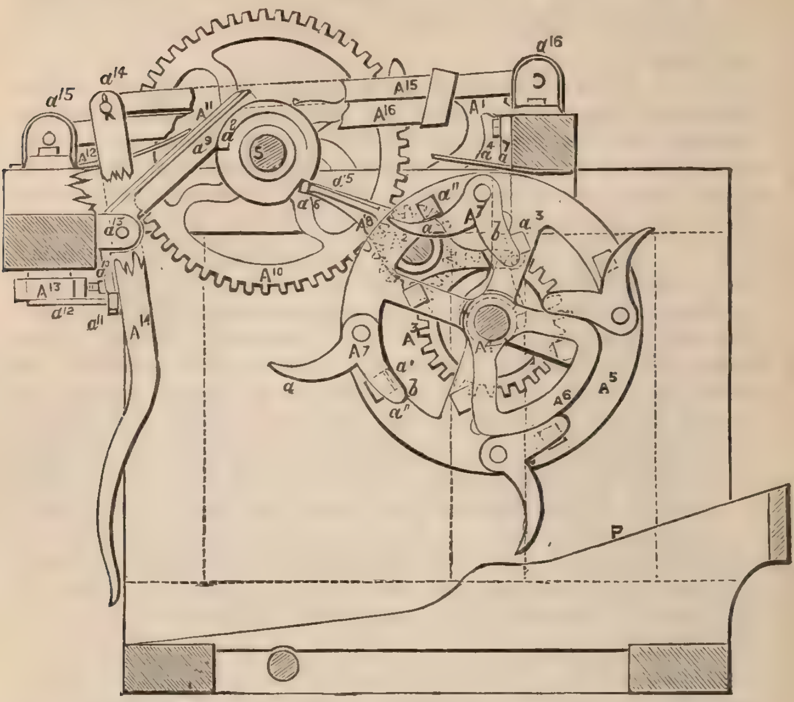
A small butter, hinged from the top of the frame, with revolving apron, can be set at different angles, according to the length of the crop, these changes being made by the driver whilst the machine is in motion, by a lever-rod. The action

of the butter is to square-up the butts of the sheaves, and has a very useful office in insuring a neat compact sheaf. The apron is revolved by bevel gear from the end of the elevator-shaft.

W. A. Wood's Binder is mounted on an ordinary Marsh Harvester frame, with a travelling apron and double elevators. Through the courtesy of the Editor of the 'Engineer,' I am enabled to illustrate some of the more important devices in this highly ingenious combination. Before, however, considering the binding mechanism, some general details of arrangements will not be out of place. The driving-wheel ($41'' \times 7''$ face) can be raised clear of the ground for transport by means of a windlass and chain, which also regulates the height of cut. The reel is capable of vertical and horizontal motion. The blades can be brought within 18 inches of the knife-bar, or raised 26 inches above, and the horizontal range varies, according to the height of the reel, from $6\frac{1}{2}$ to 10 inches. These movements are effected by a double lever and bell crank arrangement. A third lever handle, within reach of the driver, alters the angle of cut, the range of cut being from close to the ground to a height of two feet.

The main axle carries, on the outside of the driving-wheel, a chain-wheel, driving the reel through chain-gear, and on the inside a spur-wheel, 20 inches diameter, which drives the rest of the gearing. This spur-wheel engages in a pinion on a short countershaft, on the other end of which is a bevel wheel, engaging in a small bevel pinion on spindle No. 2, parallel with the axis of the machine. On its near extremity is a sproggle-wheel, a chain-wheel, and an eccentric; the former drives the canvas by a pitch-chain; the latter through a wooden pitman, operating a long crank-rod working backwards and forwards, transmits motion to the knife, to the centre of which it is attached. The chain-wheel on No. 2 shaft drives a chain-wheel, 14 inches in diameter, on shaft No. 3, from which the tying gear is actuated. At about 2 feet distance on No. 3 shaft is a small pinion, gearing into two wheels on either side, as shown in Fig. 3, which gives a vertical sectional view of the binding mechanism. These wheels are loose on their respective shafts, and are provided with spring clutch couplings. The lower shaft, No. 4, works the gathering and packing disc and fingers. These comprise two open wheels, 9 inches apart, carrying on the inner edge of their peripheries three loose fingers in the form of bell-cranks, which, in the act of gathering, are supported by fixed cams, which are part of the bearings of the shaft (see Fig. 5) A 7 and A 6. The spring clutch on the upper shaft No. 5, driving

Fig. 5.—*Section of W. A. Wood's String Binder.*

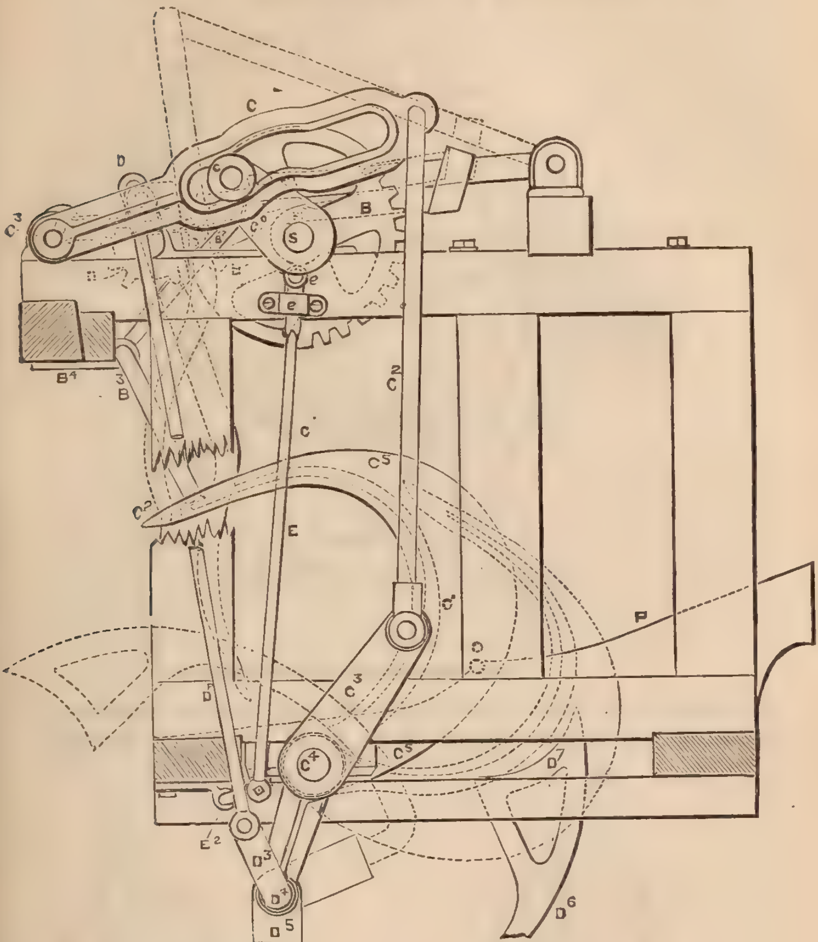


the tying gear, is provided with a cam motion, which throws the clutch out of gear during the *binding* operation, and when in gear communicates motion, first to a 12-inch pulley, and, on the opposite side of the machine, to a cam with geared segments which drives an arm underneath the table, which pushes off the sheaf when bound ; and lastly, at the extremity of the shaft, to a crank, which revolving works in a slotted lever giving reciprocating motion to a shaft, No. 6, beneath the frame, driving the binding-arms.

See Fig. 6, which gives an elevation of the machine.

The 12-inch pulley on shaft No. 5, above referred to, has on its rim gearings for one-fourth of its circumference, which engages in a small irregular pinion with two detents, which bear against the rim of the wheel and allow the small pinion to remain stationary until the geared segments engage in the detents, which then give an intermittent rotary motion to a small shaft, No. 7, provided with a small crank at its end, which, by means of a connecting-rod, supplies the reciprocating motion

Fig. 6.—*Elevation of W. A. Wood's String Binder.*

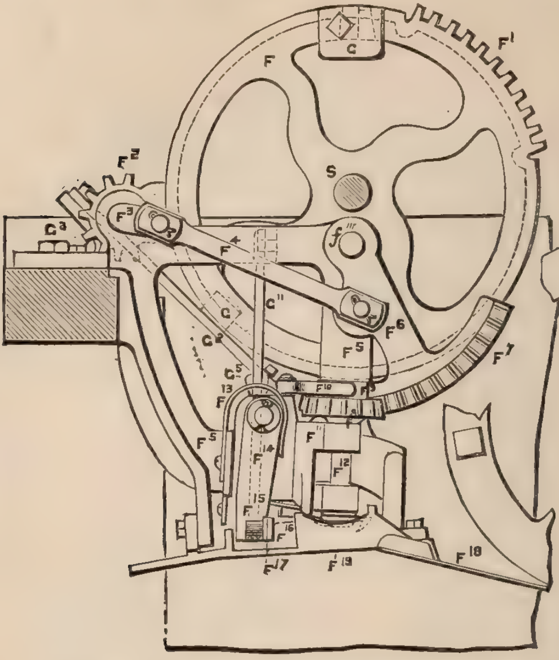


for driving the knotter. Fig. 7 shows in transverse elevation the apparatus for transmitting the motion governing the action of the knotting mechanism.

The knotter consists of a vertical spindle with a small pinion on the top, worked by a bell-crank segment, which causes it to make part of a revolution and then reverse.

On the lower end of the spindle are two hooks, the upper one provided with a barb. The lower one is double, having two fingers, the leading one of which follows somewhat behind the upper finger. In working, the double hook, string is passed over

Fig. 7.—*Transverse Elevation of the Knotting Mechanism in W. A. Wood's String Binder.*



the upper finger (Fig. 8) by the binder-arm, and the hindermost point of the bottom finger (Fig. 9) in revolving depresses

Fig. 8.

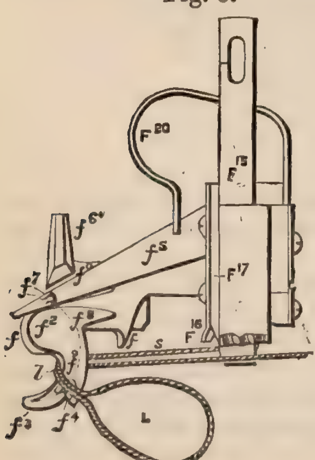
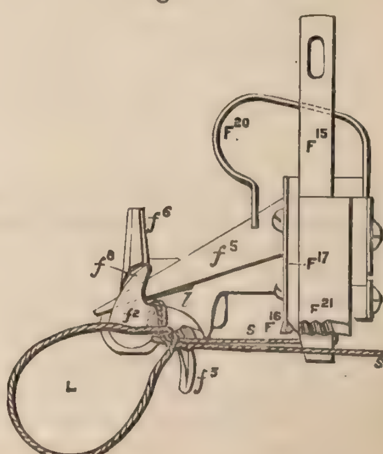


Fig. 9.



the string, which, sliding under the end of the bottom finger, is by the turn of the shaft twisted and placed between the barb and the lower hook. When the reverse motion occurs, the barbed hook moves first till the end of the string is jammed against the lower hook; then it is pushed off by a spring wiper over the point held by the barb, thus making a double-slip knot. The series of illustrations, 8 to 12, exhibit in inverted plan what takes place.

Fig. 10.

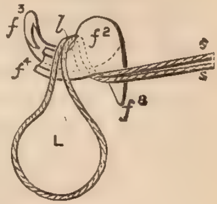


Fig. 11.

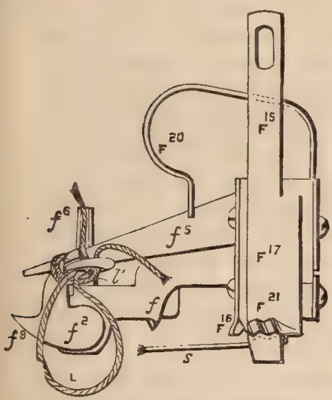
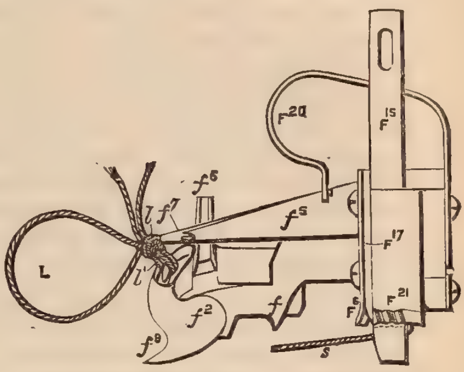


Fig. 12.



The cutter and holder * (Figs. 13 and 14) are actuated by a small roller on a lever bearing against the outer side of the

Fig. 13.

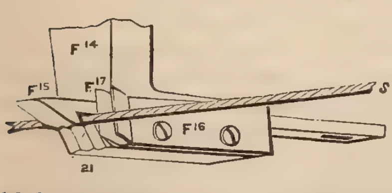
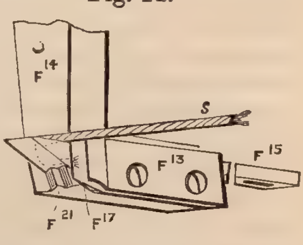


Fig. 14.



12-inch pulley on No. 5 shaft, which at one point has an indent which causes a short reciprocating motion to the holder and

* Fig. 11. Perspective view of the cutter and holder, showing the holder in the act of seizing the binding string. Fig. 12 shows, in perspective, the position of the string as held by the holder after severance of the sheaf-band and the retreat of the needle arm.

cutter, at the proper time engaging the string, and later drawing it back, cuts and retains it for the next sheaf.

The starting of the tying-gear is effected when the bundle of corn is sufficiently large to press back the spring-compressor, which then engages a lever which throws the spring-clutch on shaft No. 5, already described, into gear, and thus a uniform size of sheaf is secured, the size of which, however, can be regulated by altering the position of the lever into which the arm engages. The spring of the compressor can be regulated to a limited extent, so as to affect the density of the sheaf.

The string is contained in a tin box with a hole or guide at the top, and is carried round under the table through an eye, and then between two tension-plates regulated by a screw. Manilla string at 8*d.* per lb., which will resist a strain of 100 lbs. per 2-foot length, is preferred to hemp, being less affected by weather; $1\frac{1}{2}$ lb. per acre is said to be sufficient for an average crop. The fact of a sheaf being passed untied, which occasionally happens, does not always or generally require the machine to be stopped. The string is held, and the next sheaf is encircled, knotted, &c., as before. It will be seen that this machine is entirely automatic in its action, any control by the driver being considered unnecessary. It might, of course, happen that in the act of turning the corner a sheaf might be dropped; but as no feed is then supplied, the chances are in favour of the sheaf being carried. The design is most ingenious, and though at the trial this machine did not succeed so well as others, its merit is very great, and it is needless to add that it is admirably made. And so great has been the success of this machine, that it is stated that in the year 1881, 10,034 have been sold in all parts of the world.

Mr. H. J. H. King has been at work on String Binders longer, probably, than any other English maker; and though his present machine is very far from perfect as to finish and smooth working, being somewhat roughly constructed, and therefore not as yet capable of doing successful work, he has achieved a decided success in two important points, viz. in the perfect separation of the sheaf that is being made from the inflowing grain; and in the tying mechanism, which hardly ever failed in the trials. It is not too much to say, as regards these points, that, had the construction been equal to the conception, nothing could have prevented Mr. King's taking the gold medal, but, inasmuch as the machine was continually in difficulties, owing to defects in construction, requiring, as Mr. King rather humorously described it, a little more tuning, all that was possible was to highly commend those points in which its excellence was apparent. I shall endeavour, by the aid of a series of drawings,

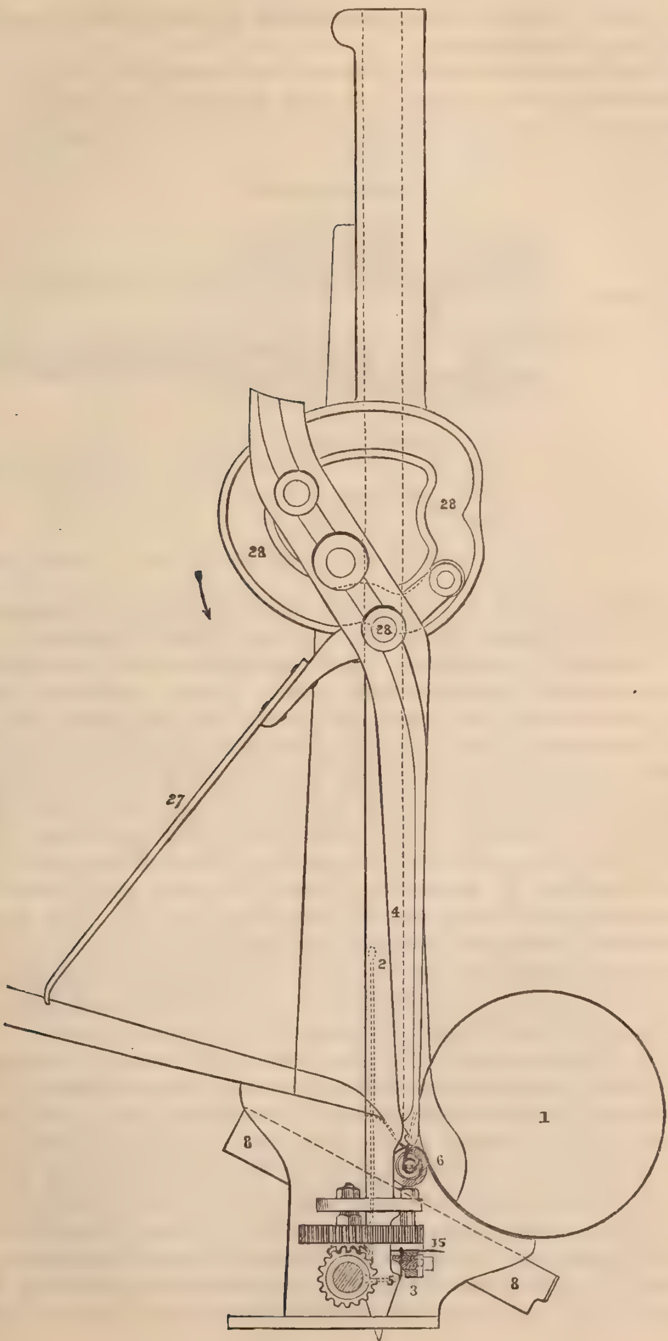
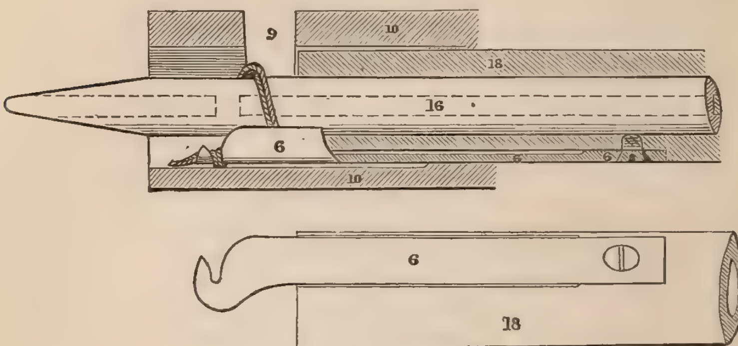


Fig. 15.—Side Elevation.

to convey an idea of the mechanism by which the tying and separating are effected.

Figs. 15 and 18 show a side and end elevation of the parts of the machine which have to do with knotting and separation of the sheaf. Figs. 16, 17, and 19 give details of the knotter.

Figs. 16 and 17.



The mechanism is attached to a Marsh Harvester frame, and there is a general similarity between King's, Bamlett's, and Hetherington's machines; indeed, as regards most details, they are constructed from the same model. King's machine is, however, provided with an automatic gear for securing uniform weight of the sheaves. On the delivery-table is a spindle with receiving forks, on which the inflowing grain collects. On the end of the spindle is a bell-crank lever, on one end of which is a weight or spring. The other end being connected by a short rod to a paul which engages in the knotting-gear. The overbalancing of the weight raises the paul and allows the binding and collecting gear to come into motion. The idea is ingenious, but the mechanism was decidedly faulty, and it was breakages at this part which caused such frequent stoppages.

Fig. 16 gives an end view of the mandril, hook case, &c.

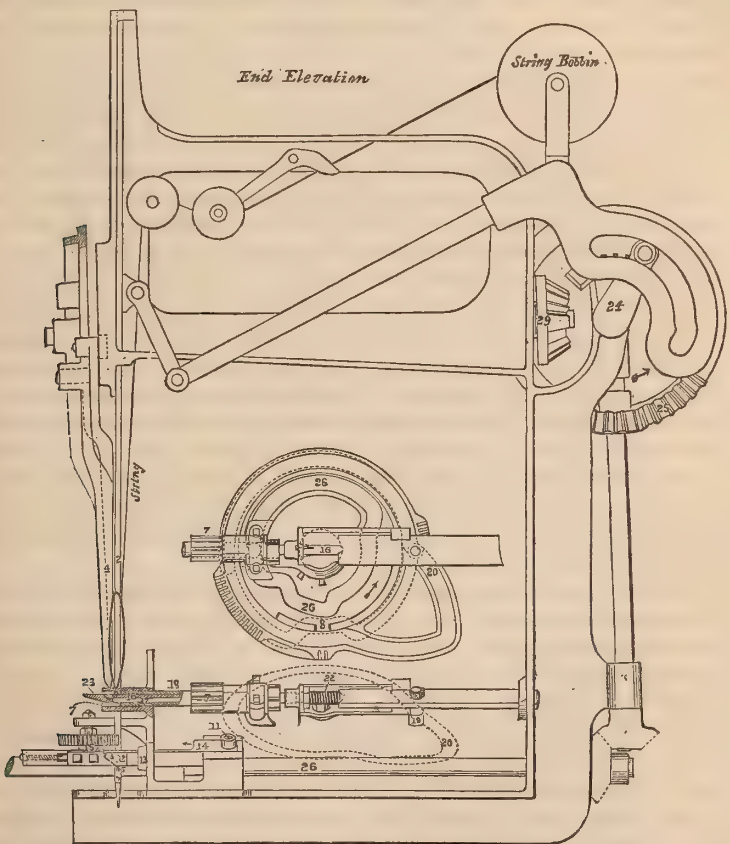
Fig. 17 is an enlarged drawing of the hook and cam.

Fig. 19 gives a plan of the cam-plate, which has such important functions in governing and directing the various motions. The position of the cam is indicated by the dotted lines in Fig. 18.

In Fig. 15—1 represents a section of the sheaf being tied. The compressor cord used for tightening the sheaf not being shown. In order to trace the process by which the sheaf is tied, it will be best to assume that the needle-arm, 2, Figs. 15 and 18, is raised, and that the string is stretched from the gripper, 3, (Figs. 15 and 18) in a straight line across the openings thus formed. The sheaf is then swept into the position shown by the

gathering-arm (4, Fig. 15). Upon the descent of the needle, the compressor-cord and strings are drawn tightly round the sheaf. As soon as the needle-eye 5 (Fig. 15) has descended within about three-quarters of an inch of the gripper, the needle pauses in its descent, and the rotary hook 6 (Figs. 16 and 17), which receives its motion through the cog-pinion 7 (Figs. 19 and 18) and groove 26 in the cam-wheel (Fig. 19) comes forward and lays hold

Figs. 18 and 19.



of the two strings, which lie in its path in the opening 9 (Fig. 16), which is the same opening that the needle passes through. This, hook 6, works in a tube or case, 10, and is so arranged that it can spring radially, and, by uniform friction against the case, hold the strings, whether coarse or fine. As soon as the hook has laid hold of the strings, and made one-third of a revolution, which ensures the strings being securely held against the case so that they cannot slip back, the gripper, 3 (which is

worked by the roller, 11, by a groove on the underside of the cam-wheel, shown in dotted lines) is opened by the buffer, 12, coming into contact with 13 (Fig. 18); thus releasing the one end of the string previously held in the gripper, and leaving an opening for the eye of the needle to pass through, which now resumes its downward course and lays the string in the gripper, which then closes by the return movement of the slide, 14 (Fig. 18), in the direction indicated by the arrow, and afterwards, being continued, brings the string against the revolving circular knife, 15 (Figs. 15 and 18), which is cut accordingly. The two ends of the string are now free to be tied in a knot, which is completed by the rotary hook, 6 (Figs. 16 and 17), winding the string round the mandril, 16, as shown in Fig. 16; the two ends being finally laid in the opening, 17 (Fig. 18). The mandril, 16 (Figs. 16, 17, and 18) is then withdrawn in 18 (Fig. 18), by the action of the roller, 19, in the cam-groove, 20 (Fig. 18), and the tongue, 21, acted on by the spring, 22 (Fig. 18), causes the ends of the string to be nipped and drawn through the loop of the knot, which is drawn against the ends of 18. The point 23 plays an important part in keeping the loop open whilst the ends are drawn through, as the string thereby takes all the slack of the knot into the ends, instead of its going towards the sheaf and thereby tending to loosen it. It is also for the same reason, viz., the tight binding of the sheaf, that the ends of the knot are drawn right through, instead of being left in a loop. It should be mentioned that the cam-wheel crank, 24, and wheel, 25 (Fig. 18) which govern the motions of the collector and binder, make one revolution for each sheaf tied. The cam being driven by a pinion on the shaft, 26.

The arrangement for separating the sheaves is shown in Fig. 15; 4 is one of the gathering-arms which sweeps the sheaf forward into the position to be bound, and 27 is the lagging arm, which is centred to 4, its relative position being regulated by the cam, 28, which is fixed to the frame. At the time when the gathering-arm enters the shower of grain falling from the elevating aprons, the points of 4 and 27 are together, so as to form one point; but immediately after the separation is made, 27 begins to lag behind, and keeps back the falling grain until at the point when the sheaf is tied the two arms are separated by 16 inches. The gathering-arms have an intermittent motion given to them by means of mutilated gear acting on the pinion 29 (Fig. 18). The arms pause during the time the sheaf is being tied, at the completion of which they discharge the sheaf.

The principal difference between King's and Bamlett's machines is that the compression of the sheaf is effected in the former by a cord, whereas in the latter the compression is effected by a double fork on a small independent shaft actuated by the cam-

wheel. These forks also act as ejectors when the sheaf is tied. As Bamlett's machine was not sent for trial, no opportunity occurred for testing the relative merit of these two systems, but King's arrangement worked admirably, as the sheaf was firmly packed, fairly uniform as to size, and the tying rarely missed.

In *Messrs. J. and F. Howard's* Binder, No. 4412, the tying mechanism is attached to a Marsh Harvester. The motion is controllable by means of a clutch lever-gear from the driver's foot. This is a useful arrangement, as allowing the sheaf to be carried round corners; but the action is otherwise automatic, and capable of regulation to deliver sheaves 10 feet, 12 feet, or 14 feet apart. This is done by change-pinions on the binder intermediate shaft. One cog gives 2 feet additional advance per sheaf. A chain-strap from one of these change-pinions drives the binder-shaft, which is placed just under the binding-table at its rear end. The other end of the binder-shaft carries the pinion, which works an endless toothed rack—an ingenious arrangement for securing a to-and-fro motion to the binder-frame, as well as the necessary intermittent movement to the binder-arm. Our readers will recognise the affinity of this mechanism to that in McCormick's wire-binder. This endless rack, which is radial and segmental, is pivoted on the travelling-table, the radial portion giving a to-and-fro travel of 18 inches, the segmental ends giving the necessary pause at the end of the travel to the binder-frame, and the radial motion to the binding-arm through a wooden connecting-rod attached to the rack. The binding-arm and tying apparatus are all mounted on the travelling-frame. The rotary motion to the knotter is obtained by a pinion on the knotter-shaft rotating on a fixed rack underneath the table. This rack has a break in its teeth, which stops the rotary motion whilst the knot is being drawn from the knotter-tube, the necessary sliding motions of the knotter-tube being obtained by levers actuated by a fixed cam-groove attached to the frame immediately under the binder-table. The whole of the moving frame consists of one wrought-iron continuous plate, sliding in two grooves on the table, with a friction-roller underneath the outer groove. The plate-bed is bent downwards in a channel form (embracing the cam-plate) to carry the knotting device. The process of binding is as follows:—As the binder-arm travels back to take more string, a knot-feeder, actuated by a spring, and regulated by a roller working against a cam-face, takes up a portion of the single string, as the binder-arm descends to inclose the sheaf. The second string is now engaged in the outer hook-tube, which is slightly drawn in and begins to revolve, twisting the string over the cam-face of the hollow hook. Now the inner hook is pushed forward, passing through the centre of the loop, and, as

it recedes, again engages the string and draws it through the loop, completing the knot. At this point a T-headed lever comes in contact with a stop on the table, and presses the string against a cutting-knife on the top side, and a gripping-jaw on the bottom. Such is a short description of mechanism which appeared simple in construction, and, when tried in the Show-yard, thoroughly efficient, but, when put into actual work, was not successful, a great many sheaves being thrown off unbound, and stoppages from choking being frequent. This is partly due to the fact that the delicate binding-gear, being immediately under the binding platform, was injuriously affected by dust and litter, and it may have been that the cam action, under the jolting action of movement, was not accurate enough for the knotter. Another defect in the general arrangement was absence of any provision whereby uniform size of sheaf can be automatically secured in a variable crop. This must depend upon the judgment and attention of the driver, who requires eyes in front to drive his horses, and eyes at the side to gauge his sheaf.

Messrs. Aultman and Co.—Article No. 4547. Reaper and Binder. Here, again, as in most of the machines, the Marsh Harvester is used as the medium for the binding mechanism. The latter is worked from a parallel shaft which runs in front of the main driving-wheel. It carries a loose clutch-wheel, which puts it in or out of motion by the action of the driver. On one end of this shaft is a small bevel-pinion, which drives a bevel-wheel with a cam on its back for regulating a sheaf-divider. This is an important arrangement, as it is sometimes difficult to prevent the sheaves becoming caught together, and hanging or dragging in their passage to the ground. On the other end of this same shaft is a small pinion, which engages a geared wheel fixed on a bracket on the side of the machine, which actuates all the tying-gear. The shaft, by means of chain-wheels and an intermediate shaft and lever, operates the needle, the necessary motion of which is obtained by the pivoting action of its arm working into a slot guide. On both sides of the geared wheel are cams; on the back face a roller engages in the cam, and works the compressor. On the front side the knotter-arm, which works on a centre, obtains its motion from the cam, also by a roller. The angle through which the knotting-arm travels should be about 75°, guided by a segment which, for part of its length, is geared into and gives motion to the knotter. The position of the knotter is about vertical. As the needle engages, the string is carried over the outer tube of the knotter, and, as the arm descends, a vertical movement is given to the inner tube (by a cam arrangement in the segment-guides), which, when the string is once engaged, descends, allowing the string

to slip over the curved finger, and be caught by the hook on the inner rod. The inner tube then ascends, the end of the string being retained by the hook and pulled through the loop. The cutting is effected by the rotary motion of the cutter immediately after the needle has engaged the second string. As will be seen from the report of the trials, this machine discharged the sheaves so badly, notwithstanding the arrangement for dividing the sheaves, that it was soon out of the race. The exhibitors explained this great defect by the absence of a "kicker," which it was stated had been left in America. The mechanism appeared very ingenious and efficient in the tying arrangement, but the scatter and waste, owing to the dragging of the sheaves, was a defect that destroyed all chance of distinction.

Messrs. Hornsby and Sons (*Limited*) exhibited a combined Reaper and Binder, which comprised many highly ingenious arrangements, but, for some reason which we had no opportunity of finding out, was not sufficiently successful in its preliminary trials to stand the tests of public trial. A short description will not be out of place. The binding mechanism is attached to a Marsh Harvester. The main binding-spindle, which runs continuously, carries at its end, which is about the centre of the machine, a spur-wheel, $8\frac{1}{2}$ inches in diameter, with a clutch-boss. This spur-wheel actuates a pinion on a short shaft which drives the packers. These are mounted on pivots on two revolving discs on either end of the shaft, and the tail-end of each packing-claw is furnished with a T-ended piece, which works alternately in cam-paths, first packing the sheaf on the outer cam-path; then, whilst the sheaf is being bound, a switch, operated on by a bell-crank, throws the T-lever into an inner cam-path, which new course causes the packers to run idle, drawing the points within the periphery of the disc. The bell-crank is pivoted to a bracket attached to the frame of the machine; the top-end carries a friction-roller, which is actuated by a cam on the clutch, mounted on the end of the binder-shaft. The machine is automatic in its action. The packing-claws, which pack and straighten the sheaf, force the corn forward against a compressing-lever, which is forced back when a sufficiency of corn is collected, liberating a shipping-clutch which throws the binding-gear into motion, and at the same time arrests the action of the packers. The knotter consists of a tube with a hook-eye, and a knotting-tube with an internal hook. The tube receives rotary motion only by a pinion actuated by the segmental gear-wheel. The knotting-tube also receives a rotary and endwise motion, and when pushed forward locks the string within the hook-eye, rendering the making of the knot apparently an absolute certainty, and

this motion is effected by levers running in cam-paths on the segmental gear-wheel. By a similar action the central hook is pushed forward to catch the ends of the string, and when drawn back completes the knot; then it is again projected to release the ends of the string and set free the sheaf. The retainer and cutter are mounted on a vibrating lever, and are so actuated by the cam-path on the segmental-wheel, and by a double gear-wheel worked by the segmental-gear, that whilst the knot is being tied, a certain amount of string is paid out, to prevent any undue strain on the string in the act of tying. The binder-arm is actuated by the segmental gear-wheels, already noticed. It is mounted in a tube carried by two bearings beneath the binder-table, and is actuated by a crank on the axis of the segmental pinion. A connecting-rod from this crank is attached to an arm on the tube, and, as the crank revolves, so the arm is raised or lowered.

The ejector is a short lever, mounted about the centre of its length to a crank-arm, attached to a spindle passing through a tube of the binder-arm. The lower end of the ejector-lever is held by a radius-rod, and can only vibrate up and down, whilst the top end which ejects the sheaf forms an ellipsis in its travel. The gear is so proportioned that the ejector makes one revolution, and then stops until the next sheaf is formed. In all its numerous details this machine was well finished, and exhibited much ingenuity of device.

Although the exhibit, No. 4325, of *Mr. J. Kearsley* was not sent forward for trial, and therefore it may be presumed was found inefficient in actual work, the simplicity of the knotting and binding mechanism justifies a short notice. The machinery is attached to a Marsh Harvester. Motion is communicated to the binding-shaft, which can be put in and out of gear, by clutch-gearings actuated by the driver through a foot pedal and lever. On this shaft is first a double cam-wheel to drive the gripper, a wiper for actuating the hook of the tying-gear through a lever; then a bevelled pinion engaging in a quadrant-arm for twisting the tying-gear, and at the extreme end a crank with cam-lever and connecting-rod actuating an intermediate shaft, on which is attached the binding, compressing, and ejecting arm. The *modus operandi* is as follows:—The corn being delivered on the table, the binding-arm descends and separates the corn for the sheaf; the string being round it, passes under the vertical knotter on one side of the head, which is an irregular spiral, and at the end of which are two fingers, the upper one fixed, the lower one movable, actuated by a swell on the binding-shaft. The binder-arm having thus passed underneath the knotter and placed the string below the movable hook, the knotter makes one revolution to the left, leading the string up the

inclined spiral, the gripper moving at the same time towards the knotter and thereby depressing the end of the string which is held; and as the knotter revolves and the string slips over the top of the spiral the preliminary twist or loop is formed. At this point the compressor descends and tightens the sheaf. In completing its revolution the lower hook of the knotter seizes the ends of the string, draws them through the loop, completing the knot, and at the same moment the string is cut. The string is contained in a box on the driver's platform, and its discharge is regulated by a tension-gear and spring.

Gleaners and Binders.

Inasmuch as article No. 4550, exhibited by the *Notts Fork and Implement Company*, was the only machine of this class that appeared on the trial-ground, I shall first describe its mechanism, and then notice very briefly the machines shown by the Johnston Harvester Company, Messrs. W. & C. Woolnough, and Mr. Geo. Spencer. Article No. 4550 comprises a strong oak frame, width 7 feet 8 inches, depth 8 feet, with a central hollow axle above, carrying the main wheel, 38 inches in diameter, and 6 inches face, of wrought iron, with iron spokes, and a small platform-wheel, 21 inches in diameter by 32 inches face. The general appearance of the machine will be seen by the accompanying figures which give an end and side view.

The platform, of which the back side is seen (Fig. 20), consists of three light steel breasts terminating downwards with three prongs, the middle breast having on its surface a steel spring-compressor which holds the corn as it ascends the platform against revolving prongs, carried on a loose sleeve on the main axle, and by this arrangement with the forward motion of the machine the corn is picked up either from swathe or bundle, and brought to the tying-gear. The spring is seen at *a* in Fig. 21. It should be stated that the main axle is mounted on a crank-arm, and is free to move over any irregularities.

Motion is derived from a spur-wheel (*b*) on the back of the driving-wheel, in which it engages by a clutch-gear (actuated by the driver) gearing into a wheel (*c*) on a small countershaft, fixed by brackets on the frame (Fig. 20). On the reverse end is a mutilated pinion (*d*), on the outside face of which is on one side a short eccentric disc, and immediately opposite a crank-pin, which, by a bent connecting-rod and bell-crank lever with mutilated bevel-pinion on its axis, gears into a quadrant on the end of a long lever fixed on a bracket on the front frame of the machine, and by means of a connecting-rod going back to the centre of the machine actuates the needle-case. The needle-case slides in a horizontal rectangular box longitudinally, ter-

minating at the end of its stroke slightly above the steel breasts.

The gearing of the mutilated pinion (*d*) drives a pinion at its rear fixed on a loose sleeve working over the central axle, on which sleeve the collecting-arms are fixed. The cam on the mutilated pinion so engages in a stop on the aforenamed pinion that the forks are held stationary in a raised position whilst the tying is in progress. The string is carried in a reel-box on the back part of the frame *e* (Fig. 20). The box revolves as the string is being drawn out, tension being obtained from a spring.

Fig. 20.

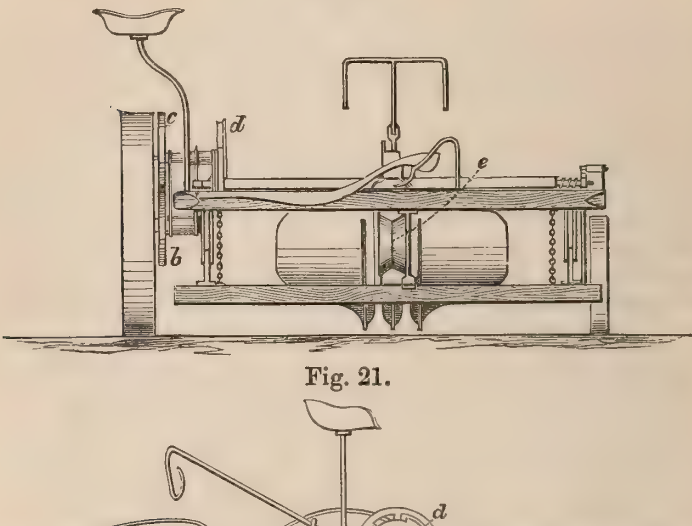
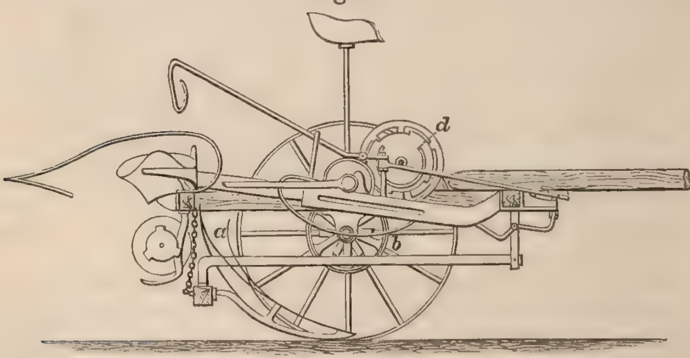


Fig. 21.



The tying-gear works backwards and forwards horizontally, and is carried or supported on slides attached to the frame. It comprises what may be described as the needle-case (*a*, Fig. 22), with a tube inside, on the end of which is a corkscrew-formed looper, auger-pointed (*b*), with a hook just behind the point. This tube has a spiral groove cut along its length, terminating in a straight slot seen at *c* (Figs. 22 and 23). A pin (c^1, Fig. 23), fixed in the needle-case cover and working in this slot, gives an intermittent rotary motion to the looper.

The string is held by a gripper with spring jaws underneath, attached to the needle-case (*d*, Figs. 22 and 23). When the needle is in its forward position and in the act of tying the knot, the needle-case engages against a stop (*e*) on a box fixed on the back of the frame (Fig. 22), is pushed back by a spring at the back of such stop, and a steel stop on the bottom of the needle-case (*f*) engages the jaws of the gripper, forces them open, and at the same time cuts the string. The gripper instantly closing by means of a spring holds the string.

The knotter is encased in a removable cover, through a slot in which the string passes, and against which the knot is tightened, the ends of the string being held in a spring catch (*g*, Figs. 22 and 23) in the box or frame.

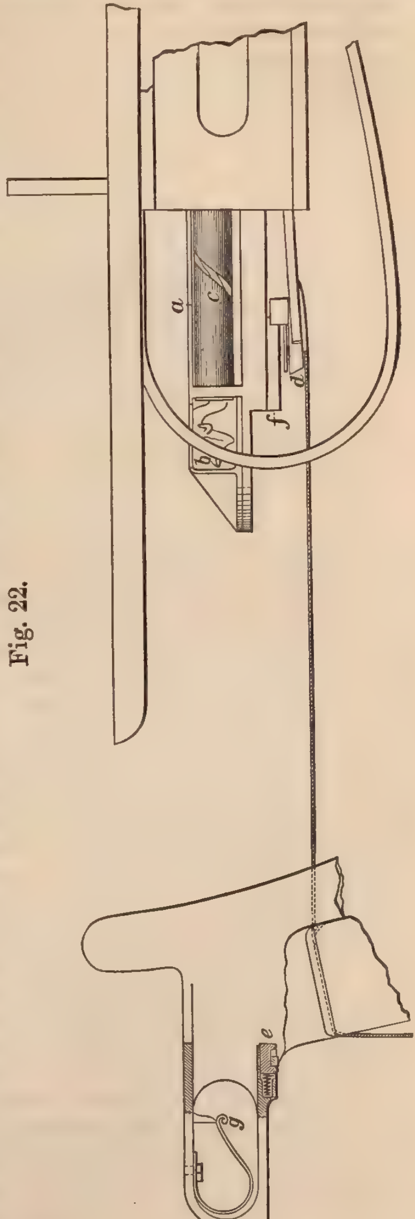
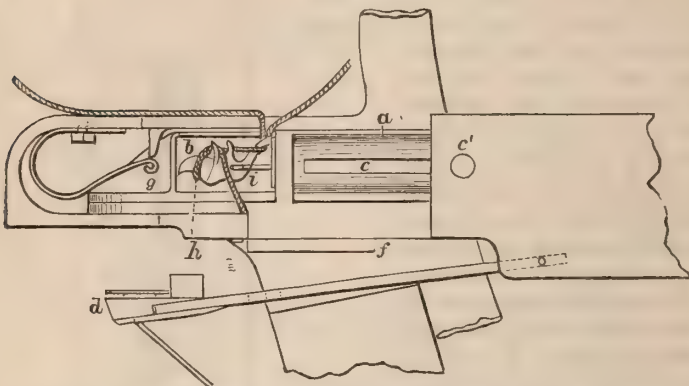


Fig. 22.

In tying the knot the string passes through a groove below the neck of the auger. It first engages in the curve of the auger point in *h* (Fig. 23), and passes on to the hook behind it. The string is looped by the revolving of the tube, and as the tube retreats the ends of the strings are pushed through the loop by the inner needle (*i*, Fig. 23) and into the spring catch on a box on the back frame (*g*). The needle-case now travelling back, reverses the motion of the knotter and the knot slips off, and is drawn tight by the slot in the cover-case. The tied sheaf is delivered

on to a hinged platform, actuated by a small crank and connecting-rod worked by a pin on the face of the pinion fixed on the loose sleeve. The mechanism is very simple and ingenious; but for some reason, possibly defective action of the gripper, whilst the corn was fairly elevated, very few of the sheaves were actually tied, and after many attempts the exhibitors withdrew.

Fig. 23.



It is much to be desired, both in the interests of the public and as a reward for the skill and enterprise displayed in this invention, that a harvest's experience may have afforded opportunities for correcting defects, and this highly ingenious machine, which is priced at 30*l*., may yet prove a success. The excellent illustrations of this machine were reduced from working drawings lent by the exhibitors.

The Johnston Harvester Company exhibited at Derby article No. 4181, an Independent Gleaner and Binder, constructed to deal either with corn laid in swathe or bundles. It was hoped that this machine, which appears to possess many points of merit, would have been sent for trial; but it did not appear, owing, it was said, to an accident on the railway, which could not be repaired in time. This is another illustration of the want of forethought in not providing duplicate parts. Possibly, however, there were other and more cogent reasons why the American Gleaner was not forthcoming. Experience in the interval may have shown defects that required amendment. The frame is 7 feet 8 inches wide by 6 feet 3 inches deep. It is worked by one horse in shafts fixed on one side of the machine and in front of the driving-wheel, the driver's seat being on the back end of the frame, with a lever handle to raise or lower the platform, which is nearly vertical, and consists of a fixed sheet-iron apron with five chain-reels armed with lifting spikes, and driven by gearing direct from the main axle by an upright shaft through two pairs

of bevel-wheels. The bottom roller of the platform is held down by springs, which give way under obstructions. From the first bevel-wheel, which has a spur-wheel attached to it, a parallel shaft drives a roller in front of the apron, furnished with teeth, which, as they revolve, direct the corn on to the apron, whilst the chain-reels carry it up. Without an opportunity of thoroughly trying such a novelty, it is, of course, difficult to form an opinion as to its working powers; but the Judges considered it possible that the almost vertical position of the apron might be objectionable in heavy crops, as the corn would have a tendency to fall back to the ground. Supposing, however, that the bundle is successfully elevated, it falls over the apron on to a receptacle and is received by the packer-arms, accumulating there until a sufficient weight is reached to overcome the spring of the compressor, which in being pushed back throws the knotting machinery into gear. The knotting-gear is driven by bevel-gearing through an inclined spindle from the main shaft. The mechanism is difficult to explain without the aid of diagrams. Motion is communicated to shaft No. 2 through a bevel-pinion with spur-wheel and clutch in one. On the other end of this shaft, which runs in a direction across the machine, is a spur-wheel actuating the packer, by engaging a wheel on a parallel shaft, No. 3, which actuates the binding-gear. This wheel is loose on the shaft and provided at the back with a clutch and cam-plate. When sufficient corn is collected to give the requisite pressure to the compressor, the latter, by means of a lever and springs, throws the clutch on No. 3 shaft into gear; and the revolutions of the cam on the back of the plate causes the disengagement of the clutch on the shaft No. 2, and stops the action of the packers whilst the knotting apparatus is in work. On No. 3 shaft is an intermittent spur-gear wheel with cam attached on the side. The gear drives an intermediate pinion, to which is connected a chain-wheel which drives the kicker-shaft. The cam acts on the lever-arm of the compressor, forcing the latter in upon the corn at the same moment that the needle comes up. The tail end of the cam acts upon the same arm, forcing the compressor away from the sheaf now that its work is finished. Beyond the cam on shaft No. 3 is another double intermittent gear-wheel, engaging into two intermittent pinions on shaft No. 4. The first of these pinions is attached to shaft No. 5, on the other end of which is a small crank-wheel which engages into a segment-gear, which meshes into a bevel-pinion on the tier-shaft. The second pinion, which has a double intermittent action, is on a sleeve, to the other end of which is attached a cam-wheel, which drives into an upright lever, the lower end of which connects to and drives the gripper

and cutter. The gripper being double only requires one movement to perform its double office, and is very simple and ingenious. The knife, being open at both ends, is not liable to choke. Great power is secured for the packing-arms by a clever arrangement of double cranks. The packer is pivoted to the first, whilst the back crank, acting in a slot, gives the necessary leverage. The action of binding is as follows:—On the lower end of the knotter-shaft is a double finger with a barb on one end, and one single finger with a rounded base. The string is led over the top of the barbed finger and held securely by the gripper. The knotter revolving two-thirds of a revolution forms the loop. At this point a stop, engaging in a catch, arrests the lower finger, whilst the upper one is completing its motion, thus causing an opening between the two fingers, in which opening the string becomes engaged. Just at this point the direction of the motion of the knotter is reversed. It returns to its original position, and the string is drawn through the loop, completing the knot. The action of the compressor in influencing the whole of the motions is very admirable. It will be gathered from the above that the knotting device is a modification of the Appleby knotter used in Messrs. Johnston's combined machine.

The last of the Independent Gleaners and Binders which was in a sufficiently advanced stage of invention to justify a short notice was that shown by *Geo. Spencer*, No. 4546 in the Catalogue—described as a Sheaf-binder, patented by the exhibitor, manufactured by Messrs. Abell, of Brook Street Works, Derby;—adapted to gather and bind with string after any ordinary reaper. The apparatus is very small, only 5 feet in width, and 4 feet 8 inches in depth. The specialty consists in the fact that the string, in place of being tied, is twisted and rubbed into a close condition which, when the machine was operated in the Showyard, made a sufficient joint to hold the sheaf; but how far this would be the case when the machine travelled, cannot be decided.

The platform is covered with sheet-iron, with one central jointed fork. A travelling rake, with two forks, under the driver's control, brings the corn to the inclined platform, on which are two light pieces of spring steel, to prevent it falling back.

The same leverage, when reversed, throws a clutch-coupling in gear with a large mutilated wheel, with cam-paths on its side; this throws the twisting-gear into action, and when the twist is made, the gear is automatically stopped, by means of a projection which disengages the clutch. The twister consists of a mushroom-shaped disc, with slots on opposite sides to receive the strings, and revolves underneath the rubbers. The twisting

is thus effected:—The teeth on the mutilated pinion are so arranged that five engaged on the pinion on the bottom shaft give sufficient motion to give one half-turn to the twister. The bottom rubber is then pushed forward, the half-twist of the string being below the rubber. There is then a blank space on the pinion, then a sufficient number of teeth to give five revolutions to the twister; after which the top rubber is pushed forward and the bottom withdrawn. The effect is, that the five twists are rolled or rubbed together into a compact condition, which is supposed to hold the sheaf. The face of the rubbers are covered with small rasp-like projections, which appear likely to injure the strings.

The Trials.

It was fortunate that in a district so largely composed of grass-land, the Society was able to secure, within four miles of Derby, crops of corn suitable for the purpose of the trials. Not only was there the necessary variety of cereals (wheat, barley), and oats, in fields closely adjacent, but crops of the same kind presented a sufficient difference of bulk, to afford the easier and severer tests required for preliminary and conclusive trials. Most of the fields were on the farm of Mr. Hall of Thulston, not unknown to fame as a breeder of Longhorns. Valuable specimens of these useful hardy animals were seen grazing in an adjacent field. A field of oats and of wheat were placed at the disposal of the Society by Mr. Radford, a neighbour, all the land forming part of Lord Harrington's Elvaston estate. And its suitableness for the purpose was suggested, and arrangements for the trials were carried out by Mr. Gilbert Murray, the agent for the estate, and an active member of the Local Committee. The forcing weather that characterised the Show week, considered in connection with the warm gravelly soils on which the crops grew, led the local authorities to fix August 1st as the proper date for the trials. Subsequent events modified this view, and eventually the actual trials commenced on Monday, the 8th; competitors having an opportunity to work their machines in a field of oats on the previous Saturday. It may be said in passing that the putting back the trials until the crops were in a fairly ripe condition was a judicious step. The object being to test the machines under as nearly as possible similar conditions to those of ordinary work, it was necessary that the crops should be as nearly as possible in the stage at which they would be cut in the ordinary way. The oats were quite ripe enough; indeed, as a general rule, they would have been better cut three or four days sooner. The wheat was in excellent con-

dition, and the barley sufficiently ripe to afford a fair test. At both Liverpool in 1877, and Bristol in 1878, the crops were too green, and there might have been a difficulty in deciding had the competition been very close.

The weather, which is so important a factor in meetings of this kind, was far from propitious. Heavy and continuous rain stopped operations on Monday which had been commenced under very flourishing conditions, and prevented a start before noon on the second day, whilst driving showers on the Wednesday interfered with work for at least two hours. Nevertheless the Judges had ample opportunities to satisfy themselves as to the relative merits of the different machines. Hence all the objects of the trials were accomplished, and it seems rather unreasonable to complain, as some of the newspapers did, that they were not prolonged merely for the satisfaction of the reporters. Such prolongation in such broken weather would have added considerably to expenses, which were heavy enough as it was. However good the arrangement for preventing injury to the crop from the public, it is impossible to prevent waste of corn at trials open to the public, and which attracted so many spectators as those at Derby. To have prolonged the trials after all the requirements were fulfilled, would have increased the waste; and whatever the critics may have felt, there is no doubt that Mr. Hall regarded the conclusion of the matter with unmeasured satisfaction. Indeed this gentleman's feelings throughout the trials claimed our sympathy. His nervous organisation was severely tried. He took a proper pride in his crops, and when he saw some portion of his barley being cut in the wet, his feelings got the better of him, and he retired in distress, only reappearing with the sun. We have no doubt that he greatly exaggerated the damage, for which of course he would get compensation.* But even if some loss occurred, the cutting of a portion of the crop in a damp condition was not without its advantage, as showing what the machines could do under difficulties; and very remarkable was the work done on Monday afternoon, even during a considerable downpour, by some machines, whereas others were unable to cut at all. The figures which are appended will convince the reader as to the results arrived at; but it may be stated that the dissatisfaction of the public as to the awards arose from the fact that they judged the machines from a different standpoint, and viewed their work as a whole, whereas the Judges confined their attention to *efficiency of binding and separation of the sheaf.* It is quite reasonable that those who looked at the work generally

* His letter, of which an extract has been introduced, favours this view.

were greatly surprised at the selection of a machine for the first prize, which did not so much cut as tear the stems away from the ground, a result entirely owing to defects in the knife, which, having been exposed to the action of sea-water during the time the steamship *Britannic* was under water, had become so brittle that the serrations chipped off, leaving, of course, a blunt surface.

One other point requires explanation before I proceed to describe the trials. It will be seen by the conditions of trial, that beans were included in the crops that were to be cut, and two fields were found in the locality, both of spring beans, which were quite a month off harvesting ripeness. Under these circumstances only two courses were open—either to adjourn the trials until the beans were ripe, or to omit this part of the programme altogether; to do which the unanimous consent of the competitors was necessary. In order to obtain their opinions, a meeting was called by the Stewards, the state of the case laid before them, and they were all agreed to abandon the bean test. Although this was one of the conditions desired by the Implement Committee, the Judges did not attach very much importance to the test; firstly, because the area under beans is not large or increasing, and secondly, because it is doubtful whether the cutting of beans by machinery is either a practicable or an economical process.

Before describing the Trials I may repeat the conditions under which they were held. In the general regulations issued by the Society for the Derby Meeting, the Judges were empowered to award a Gold and Silver Medal to the Sheaf-binding Machines which, after the Trial, during the harvest-season of 1881, should in their opinion be the best and the second best—the binding material to be other than wire.

CONDITIONS.

1. The Machines must be brought complete into the Showyard for examination, description, and weighing.

2. The makers must declare the number of horses and attendants that each machine will require.

3. The strength of the bands will be tested as at Bristol.

4. The Machines Entered for Trial and selected by the Judges, will remain in the possession of the respective exhibitors up to the time of Trial, with a view to enable the exhibitors to work and improve their machines between the close of the Show and the time fixed for the Trial; and any exhibitor whose machine shall be selected by the Judges, and who does not produce it at the time, shall forfeit 25*l*. for each machine not thus submitted.

5. Broken or injured parts cannot be replaced during the time of the Trials without the consent of the Stewards, unless they are duplicate parts liable to injury.

The chief difference in the above and the conditions affecting the Trials of 1877 and 1878 will be found in the fourth clause

allowing intending competitors to retain possession of their machines between the termination of the Show and the date of trial ; a wise alteration, inasmuch as an opportunity might occur for preliminary trial and for improvement of detail—of great importance when the short interval during which harvest operations are possible, and the consequently extremely limited opportunities for experience in actual work are considered, the risk of default being provided for by a heavy penalty for any machine absent from the trials. That the institution of this penalty was a wise and reasonable precaution will be gathered from the fact that, whereas twenty distinct machines were shown at Derby as entered for trial, only eight put in an appearance at Thulston ; and as the Society incurred very considerable expense in providing land for the trial of the larger number, it was only reasonable that absentees should contribute towards such expenses. Besides the general conditions already noticed, a series of special conditions were issued to each competitor, of which the following is a copy :—

1. Notice of the place and date of the trials will be posted to every Competitor as soon as they are fixed.

2. Every Competitor must himself provide for the delivery of his machines on the Trial ground, and for the removal of the same after the Trials.

3. Horses will be provided by the Society to work machines during the Trials, but Competitors who desire it may provide their own horses.

4. Every machine must be delivered at the dépôt on the Trial grounds in proper working order, before 9 A.M. on the first morning of the Trials.

5. Exhibitors are expected to provide their own drivers and attendants, but the Society reserves the right to provide men and to work any machine if an Exhibitor is absent, or not ready, or who says that his men are absent, after due notice has been given to him to bring his machine out for Trial.

6. All machines, whether Binders only or combined Reapers and Binders, will be tried in the same or similar crops. The Binders will work on swathes cut for them by a modern pair-horse swathe-delivery machine, and also on a crop cut by a sheaf-delivery machine.

7. Before starting work on any plot, the Exhibitor must declare the number of men and horses required by his Machine. If he personally, or any other extra attendant not included in such declaration, should render any actual assistance in working or adjusting the machine during the Trial, the fact will be noted by the Judges.

8. The height of cut must not in any case exceed an average of 6 inches.

9. The Judges and Engineers will as far as practicable note the time occupied, the number and duration of stoppages, the area passed over, the width and height of cut (by Reapers), the mode of delivery and position in which the sheaf is left, the waste of corn in the operation of binding, the size and condition of the sheaves in each trial, and the economy of power.

10. In examining the sheaves and the knots in the bands, the Judges will attach most value to binding which is secure for handling without extreme tightness of sheaf.

11. In addition, the following qualifications will be chiefly considered by the Judges in assessing the relative merits of the several machines and their performances.

12. Simplicity and efficiency of construction.

13. Weight.
14. Cost.
15. Adaptation for English Farms.
16. Quality, Strength, and Cost of binding materials.
17. Security of knot.
18. Efficiency in Binding Wheat. Perfection valued at 100 points.
19. „ „ Barley. „ 100 „
20. „ „ Oats. „ 100 „
21. „ „ Beans. „ 50 „

It will be seen by a reference to the above, that the trial was confined to a comparison of the binding mechanism of different machines, whether such was a part of or separate from cutting machines. As a matter of fact only one separate binder was brought to trial out of several that were shown at Derby. The Judges, in making their awards, had not, therefore, to consider any points of merit in reference to motion and action prior to the delivery of the corn upon the binding platform; a fact which, if it had been duly considered by those who reported for the newspapers, might have led them to take a less unfavourable view of the verdict arrived at.

Out of the twenty machines that were exhibited at Derby, the following were present:—

No. 1. Samuelson and Co., 4491.
No. 2. W. A. Wood, 4556.
No. 3. The Johnston Harvester Company, 4183.
No. 4. McCormick Harvesting Machine Company, 4400.
No. 5. J. and F. Howard, 4412.
No. 6. Aultman and Co., 4547.
No. 7. H. J. H. King, 4554.
No. 8. Notts Fork and Implement Company, 4550.

With the exception of the last, which was a solitary example of a binder separated from a reaping machine, the above cut their preliminary lots of oats in the order named. The crop was light, upstanding, and variable, but offering very favourable conditions for good work; indeed, any mechanism that could not deal with such a crop in a satisfactory manner was quite useless for ordinary work.

1. Samuelson.—Good delivery, clean and well separated, two stoppages from string breakings. Considerable loss from shedding of grain partly from too rapid revolution of fans and partly from undue pressure between the elevating aprons. Sheaves well formed, fairly uniform as to size, with good square butts.

2. W. A. Wood.—Missed tying 37 sheaves in half an acre, delivery of sheaves occasionally assisted by attendant.

3. Johnston Harvester Company.—Once choked. One sheaf untied, one sheaf helped off by attendant. Sheaves caught together three times, separation not quite perfect, and corn not laid quite evenly in the sheaf.

4. McCormick.—Excellent delivery; missed tying one sheaf in de-

livering the sheaf, the butts always first on ground, sheaves fall very lightly in consequence. The regularity of the form of sheaf is partly due to a shifting board for straightening the heads.

5. Howard's Machine.—String broke several times. Sheaves caught and hung. Missed tying 17 sheaves.

6. Aultman and Co.—Attendant constantly helping off sheaves. Much scatter. 13 sheaves untied.

7. King's.—Constantly stopping, principally because the collecting arm overran, evidently not in working order. Mr. King continually tinkering without success.

In the afternoon, notwithstanding the damp condition of the barley, a start was made. Some of the machines could not work at all, others, especially McCormick's, got through creditably, considering the very unfavourable state of the crop. On Tuesday a start was made about noon; the corn being still somewhat damp. Those machines that could not get through the half-acre plots of barley on Monday completed their tasks, and generally did much better, as the grain was in fair condition. The field containing 13 a. 1 r. 23 p., a heavy long-strawed crop of oats, varied considerably, being stoutest at the top end, and was laid out in five 2-acre plots. The very heavy rain of the previous night had partly laid the crop, and, owing to being somewhat over-ripe also, the heads were considerably tangled, making successful delivery very difficult; this was a severe test, and the work was on the whole highly creditable. The notes that were taken may be briefly epitomised. In this trial time was taken and all details noted.

1. Samuelson was the first to start at 10 o'clock, and had probably the heaviest piece of cutting; two men were found absolutely necessary, one to drive and the other to watch the delivery and help off sheaves which otherwise dragged. The sheaves were somewhat rough. Grain knocked out by rapid motion of reel. Considering the length of straw and the weight of crop made a very creditable run.

2. W. A. Wood.—Sheaves thrown off with considerable violence prejudicial in an over-ripe crop. Heads of sheaves caught against corner of platform, and sheaves frequently hung together. Delivery bad and scatter considerable. Sheaves large, rough and heads and butts mixed. 50 sheaves unbound. Stopped 19 times. Crop rather shorter than Plot 1, but very heavy.

3. McCormick.—Started with one man, but found it impossible to proceed, as machine clogged without a second attendant. Several untied sheaves, and sheaves hung, owing to binding table being too narrow. Fairly good work, crop lighter than Plots 1 and 2. Sheaves the neatest and most regular.

4. Johnston Harvester Company.—Crop lighter and easier to cut. The tying very good indeed, only four sheaves missed. Separation not good, considering that the crop was so much lighter.

5. Howard.—Separation very bad, string broke repeatedly, and a large number of sheaves were untied.

The following Table, compiled by Mr. Courtney, the Assistant-Engineer, gives the principal facts as to this trial:—

TABLE I.—RESULTS of TRIALS of COMBINED REAPERS and SHEAF-BINDERS on OATS at DERBY, August 9, 1881.

NAME OF EXHIBITOR.		McCormick.	Samuelson.	Johnston Harvester.	Wood.	Howard.
Crop		Oats	Oats	Oats	Oats	Oats
Condition of Crop		Heavy. Over ripe. Partly tangled and leaning. Straw long and difficult to cut.				
Weight of Crop per Acre		10,723 lbs.	11,008 lbs.	10,592 lbs.	10,841 lbs.	10,205 lbs.
Area of Plot		2 acres	2 acres	2 acres	2 acres	2 acres
Nett time cutting		1 hr. 42 m.	1 hr. 18 m.	0h.43m.40s.	0h.51m.19s.	1 hr. 34 m.
Width of Cut		4 ft. 6½ in.	4 ft. 6½ in.	..	4 ft. 8 in.	4 ft. 10 in.
No. of Sheaves per acre		879	754	728	586	1173
Weight of Sheaves	Max.	13½ lbs.	17 lbs.	18 lbs.	21½ lbs.	10 lbs.
	Min.	9 „	10½ „	12 „	13 „	8 „
	Mean of Total No. of Sheaves	12·2 „	14·6 „	14·55 „	18·5 „	8·7 „
Girth of Sheaves	Max.	29½ ins.	32 ins.	34¼ ins.	33¾ ins.	33½ ins.
	Min.	28 „	27½ „	30 „	29¼ „	23 „
	Mean of Total No. of Sheaves	28·6 „	30·65 „	31·3 „	31·15 „	27·8 „
Number of Sheaves untied		17*	16†	4‡	50§	56‖
Nature of string used		Manilla	Hemp	Manilla	Manilla	Hemp
Weight of string used per acre		3lbs. 1·68oz.	2lb. 11·45oz.	2 lbs. 15 oz.	2 lbs. 7 oz.	4 lbs.
Cost of string used, at 8½*d.* per lb.		2*s.* 2½*d.*	1*s.* 11*d.*	2*s.* 1*d.*	1*s.* 8¾*d.*	2*s.* 10*d.*
Breaking strain of string band	knot up	197	95	122	95	90
	knot down	245	130	242	186	250
Mean breaking strain of wire bands as per Bristol Experiments	knot up	..	..	85	..	..
	knot down	..	..	132	..	..
Breaking strain of straw bands as per Bristol Experiments	knot up	..	..	217	..	..
	knot down	..	..	275	..	..

REMARKS.

* McCormick.—Very little assistance to delivery.

† Samuelson.—In addition to the sheaves left untied, machine choked twice and had to be cleared, and sheaves constantly assisted by attendant.

‡ Johnston Harvester.—The number of untied sheaves small, but attendant was constantly occupied in assisting deliveries.

§ Wood.—Sheaves hung together and dragged, but very little assistance given.

‖ Howard.—String broke 25 times.

The weight of crops was calculated by the number of sheaves made by each machine multiplied by the mean weight. This must be regarded as an approximation rather than the actual weight, as the whole of the sheaves were not weighed. It will be noticed that the sheaves made by McCormick's machine were more uniform than any, except Howard's, which were too small. Another point of considerable importance in a damp climate is the relative size of the sheaves. Wood's sheaves were more than half as heavy again as McCormick's and con-

siderably heavier than either of the Silver-Medal machines. Another noticeable feature is the comparative uniformity of weight and size. In both these important points McCormick's machine takes a strong lead. There is one other remark that may be made as to the comparative weight and girth of McCormick's and Wood's sheaves; although the latter average one-half heavier, they only exceed in girth by about 10 per cent., proving that they were more tightly tied, a result which was anticipated from the action of the packers, which appear to give the sheaf a greater squeeze than is the case in the Appleby packers. As far as the breaking-strain is an indication of a superior knot, McCormick again comes to the front.

A preliminary trial in a very light crop of wheat was made by six machines on Tuesday night.

On Wednesday the morning was fine, but several rather heavy showers interfered with the work up till noon, after which a brisk wind and sun rapidly dried the wheat. Four machines were sent into 2-acre plots of wheat, thin on the ground, and leaning so much that cutting all round was not possible in every case. The machines were Samuelson's, Wood's, McCormick's, and Johnston's—the latter having only an acre. Wood's machine did better than in the oats, but a number of sheaves were unbound; there was a good deal of scatter, and the separation was not good. McCormick's plot was not easy to work, as the corn leaned over more than the others, necessitating one-way work. The knife was very blunt and the cutting very bad, but the binding and separating were again decidedly superior, and, as this machine had taken a decided lead throughout the trials in those points as to which we were called upon to decide, it was considered unnecessary to carry on any further trials. The Johnston Harvester Company and Samuelson had run so close that it was thought desirable to give them another test, and as King had got his machinery so far "tuned" that he had done much better on a small plot of wheat than hitherto, it was decided to send him in as well. A stout crop of wheat of Mr. Radford's was available. The wind was rough and the work was difficult. Now Samuelson had the worst plot to cut, though not the heaviest, and, barring the breaking of the lever-arm (cast metal), which throws the binding apparatus automatically into gear, made very creditable work. The Johnston Harvester Company, in an easier plot, did extremely well, and, as merit was so equally divided, the Judges recommended, and the Stewards sanctioned, the award of the Silver Medals, highly commending the binding and separating mechanism of King's machine.

TABLE II.—RESULTS of TRIAL of COMBINED REAPERS and SHEAF-BINDERS on WHEA[T] at DERBY, August 10, 1881.

NAME OF EXHIBITOR.		McCormick.	Samuelson.	Johnston Harvester.	Wood.	Second Trial. Johnston Harvester.	Second Trial. Samuelson.
Crop		Wheat	Wheat	Wheat	Wheat	Wheat	Wheat
Condition of Crop		Thin, but leaning a good deal.				Stout and longer an[d] waving about.	
Weight of Crop per Acre		10,411	9845	11,203	11,328	11,552	9075
Area of Plot		2 acres	2 acres	abt. 1 acre	2 acres	2 acres	2 acres*
Nett time cutting		1 hr. 16 m.	1h.50m.15s.	..	..	..	1 h. 2 m.
Width of Cut		4 ft. 7 in.	4 ft. 5½ in.	..	4 ft. 8 in.	..	4 ft. 7½ in.
No. of Sheaves per Acre		432	550	445	550	568	abt. 660
Weight of Sheaves	Max.	28 lbs.	28 lbs.	31 lbs.	31 lbs.	24 lbs.	17 lbs.
	Min.	18½ „	6 „	20 „	20 „	16 „	10 „
	Mean of Total No. of Sheaves	24·1 „	17·9 „	25·4 „	23·65 „	19·7 „	13·75 „
Girth of Sheaves	Max.	34 in.	29½ in.	34 ins.	31 in.	31½ in.	31¼ in.
	Min.	30½ „	14 „	29½ ins.	27½ „	29 „	29 „
	Mean of Total No. of Sheaves	31·05 „	26·3 „	31·25 „	28·6 „	30·5 „	29·8 „
Number of Sheaves untied		7	25†	not taken	not taken	..	..
Nature of String used		Manilla	Hemp	Manilla	Manilla	Manilla	Hemp
Weight of String used per Acre		2½ lbs.*	3 lbs. 0¾ oz.	1lb.11·25oz.	2 lb.15·1oz.	2 lbs. 4 oz.	2lbs. 8·65oz
Cost of String per Acre at 8½*d.* per lb.		1*s.* 9¼*d.**	2*s.* 2*d.*	1*s.* 2½*d.*	2*s.* 1*d.*	1*s.* 7*d.*‡	1*s.* 9½*d.*
Breaking Strain of String Band	knot up	197	95	122	95	122	95
	knot down	245	130	242	185	242	130
Mean Breaking Strain of Wire Bands as per Bristol Experiments	knot up	..	..	85	..	..	..
	knot down	..	..	132	..	..	..
Breaking Strain of Straw Bands as per Bristol Experiments	knot up	..	..	217	..	..	..
	knot down	..	..	275	..	..	..

REMARKS.

* McCormick.—The weight and price per acre of string calculated for that actually used, which was wet, having been submerged with machine in the Britannic. After drying it weighed 2 per cent. less than the Johnston Harvester, and was actually less per acre.

† Samuelson.—Besides those left uncut there were 75 small sheaves.

2nd Trial.

‡ Johnston Harvester.—The increased cost of string was due to a heavier crop.

Samuelson.—Owing to a breakage of part of the machinery, about ¼ of an acre was left uncut.

It was quite impossible to get any valuable facts as to King's results, owing to his frequent stoppages for repairs and alterations. It was only on the third day that he was able to get along so that the public could fairly judge of the real merit of his invention. Mr. King thus explains the reason for his want of success: "Our misfortunes arose through having no arrangement to lock the gathering-arms in the position we wanted them to assume after the sheaf was thrown off, the consequence being that the gathering-arms, when the horses varied their speed, assumed different stopping positions, generally going round too far, and stopping the shower of grain falling upon the scale. This was the cause of the constant stoppages during the first two days. By introducing a little more friction we almost cured this defect, our work on Wednesday being in this respect very fair, though by no means perfect"; and he adds that he regrets, with such a limited experience, going into the trials with the weighing attachment on. From what was done on the last day, it was quite evident that, if the machinery had been accurately made, the separation and binding would have been excellent; indeed, as regards the latter, the result appears a perfect success, as the knot was always made, and fairly good sheaves produced. When properly constructed this machine must prove a valuable addition to our labour-saving novelties. Great credit is due to Mr. King for his perseverance under difficulties which would have daunted many, and we cordially wish his enterprise success.

The Judges arranged a scale of points under the following heads:—

1. Simplicity of construction and material.
2. Security of binding; uniformity, size and character of sheaf.
3. Separation and delivery of sheaf.
4. Ease of management and economy of labour.
5. Freedom from waste.

The notation of the four leading machines in all other trials was as follows:—

McCormick	240
Johnston Harvester Company Samuelson	219
W. A. Wood	196

The award made on the evening of Wednesday was as follows:—

The Gold Medal: The McCormick Harvester Machine Company for their reaper and binder. No. 4400.

Two Silver Medals: Messrs. Samuelson and Co., No. 4491. The Johnston Harvester Company, No. 4183.

Highly Commended: Mr. H. J. H. King (No. 4554), for principle of tying and separating sheaves.

On behalf of my colleagues, Messrs. Kimber and Scotson, and myself, I desire to express our thanks to the Stewards, Secretary, and Officials for their zealous exertions to facilitate our work in every way; and I desire also to express my personal obligations to Messrs. Anderson and Courtney for the very valuable assistance afforded me in the description of the machinery which has been attempted.

XI.—*Report on the Field and Feeding Experiments conducted at Woburn on behalf of the Royal Agricultural Society of England during the Year* 1881. By Dr. AUGUSTUS VOELCKER, F.R.S., Consulting Chemist to the Royal Agricultural Society.

EXPERIMENTS ON THE CONTINUOUS GROWTH OF WHEAT.

THE experiments on the continuous growth of wheat were instituted in 1876, and as the tenant grew a crop of wheat in 1875, I have now to report the result of the sixth year's continuous growth of wheat on the same field.

Directly after the removal of the wheat-crop of the previous season, the land was ploughed shallow, drag-harrowed, and thoroughly cleaned, before the seed was sown. Nine pecks of Browick wheat were dibbled in on the 22nd and 23rd of October, 1880, when the land was in a first-rate condition for the reception of the seed-wheat. It appeared above ground on the 7th of November.

The mineral manures in the quantities given in the tabulated results in the following pages were sown on the 22nd of December, 1880, and the salts of ammonia and nitrate of soda, diluted with three or four times their bulk of dry sand, were sown on the 29th and 30th of March, by a broadcast manure-distributor.

The dung required for the experiments on the continuous growth of wheat and barley was made by six bullocks, three making dung for the wheat, and three for the barley experiments. Each bullock received daily $5\frac{2}{5}$ lbs. of decorticated cotton-cake, $8\frac{1}{2}$ lbs. of Indian corn-meal, 64 lbs. cabbages, and $10\frac{1}{2}$ lbs. of wheat-straw chaff. They were put into the feeding-boxes on the 20th of October, 1880, and in the course of five weeks consumed:—

5 cwts. of decorticated cotton-cake,
8 cwts. of Indian-corn-meal,
3 tons of cattle-cabbages, and
10 cwts. of wheat-straw chaff.

They were supplied with 13 cwts. of wheat-straw as litter, cut into chaff of about 2 to 3 inches in length.

When put into the feeding-boxes on the 20th of October, 1880, the three bullocks weighed respectively:—

	cwts.	qrs.	lbs.
No. 1.	11	2	11
„ 2.	11	3	17
„ 3.	11	1	7
Total weight of three bullocks on the 20th Oct. 1880 ..	34	3	7

On the 22nd of November, 1880, when the stated quantities of food had been consumed, the bullocks were weighed, with the following results:—

	cwts.	qrs.	lbs.		Gain from Oct. 20 to Nov. 22, 1880 (5 weeks). qrs.	lbs.	
No. 1. weighed	12	1	21	....	3	10	Total gain in 5 weeks: 2 cwts. 1 qr. 8 lbs.
„ 2. „	12	2	3	....	2	14	
„ 3. „	12	0	19	....	3	12	
Total weight of three bullocks on the 22nd Nov. 1880 ..	37	0	15				

The three bullocks thus gained 52 lbs. per week, or each bullock on an average increased $17\frac{1}{3}$ lbs. per week, or about $2\frac{1}{2}$ lbs. per day.

The dung was removed from the feeding-boxes and placed into a covered hovel, closed on all sides, and thereby all loss by drainage was avoided.

The weight of the dung on the 10th of January, 1881, or six weeks and six days after removal from the feeding-boxes, was 2 tons 11 cwts. 1 qr. and 24 lbs.

The requisite quantity calculated to contain nitrogen equal to 100 lbs. of ammonia was put on plot 10 on the 10th of January, and double that quantity, calculated to contain nitrogen equal to 200 lbs. of ammonia, was put on the same day on plot 11.

The wheat was repeatedly hand-hoed and rolled; and was kept thoroughly free from weeds.

On plots 2 and 3 the wire-worm did damage, but the blanks on these and other plots were filled up by transplanted wheat, and on the whole a regular plant was obtained on all the plots. The wheat was cut on the 11th of August, except on plots 2 and 3, upon which the wheat was not ripe at the time, the harvest there being delayed until the 22nd of August.

The wheat was carted and stacked on the 20th of August, except that of plots 2 and 3, which was carted and stacked on the 26th of August. It was threshed in the field by means of a a portable threshing-machine, on the 12th of October. The

straw of each plot was weighed in the field, and the corn of each plot bagged, carefully labelled, and stored in the granary until the 20th of October, when the gross weight of corn from each plot was ascertained, the whole of the produce was measured out, and the weight of each bushel taken. In each case the gross weight agreed well with the weight obtained by adding the weights of the number of bushels which each plot produced.

Table I., on the next page, shows at a glance the treatment of each plot as regards manure, and the results of the harvest of 1881.

The wheat was cut and stacked in a capital condition before the wet weather at harvest-time set in.

Although the wheat-crop in 1881 yielded badly in many parts of England, the wheat at Woburn turned out better than in any previous year since the institution of the Experiments.

It will be in the recollection of most persons that the spring and early part of summer of 1881 was fine, warm, and promising a good corn-harvest. Unfortunately the prospects of a good corn-harvest were blighted in many places by the cold and wet weather which set in towards the end of August.

Fortunately the wheat-crop on Crawley Farm, Woburn, arrived at early maturity, and was cut on the 12th of August, and was safely stacked before the continuous wet weather in August and September set in. It is worthy of notice that the wheat had been sown as early as the 20th of October, 1880, for I am much inclined to think that owing to this circumstance the wheat was in a sufficient advanced state of growth when the fine spring weather of last season set in, and in a condition to derive greater benefit from the warm and genial weather in July than wheat sown later in the autumn.

Both in the experiments on the continuous growth of wheat and in the rotation experiments the wheat in 1881 looked more luxuriant throughout the season than in any of the preceding five years.

After having grown without manure five crops in succession, the experimental field in 1881 grew the sixth crop of wheat, which was heavier than in the second or any of the preceding five years. This is all the more surprising, because the soil of the experimental field is rather a light and good barley-soil than good strong wheat-land.

The influence of season in connection with early or late sowing is strikingly shown in the results of the wheat-harvest of 1880 and 1881. Last year the wheat was dibbled in as early as the 20th of October. In less than a fortnight it germinated and pushed through the soil, and in a month's time after sowing a strong and even plant could be noticed on the field.

TABLE I.—PRODUCE OF CONTINUOUS WHEAT. FIFTH SEASON, 1881.

Plots.	Manures per Acre.	Produce per Acre.					
		Dressed Corn.			Straw, Chaff, &c.		
		Weight.	Number of Bushels.	Weight per Bushel.			
		lbs.		lbs.	cwts.	qrs.	lbs.
1	Unmanured	1460	25·7	57¼	19	2	27
2	200 lbs. ammonia-salts alone, applied in the spring)	1744	31·7	55	20	3	24
3	275 lbs. nitrate of soda (applied in the spring)	2238	41	54·6	27	2	1
4	200 lbs. sulphate of potash, 100 lbs. sulphate of soda, 100 lbs. sulphate of magnesia, 3½ cwts. superphosphate of lime	1606	28·2	57	20	1	10
5	200 lbs. sulph. potash, 100 lbs. sulph. soda, 100 lbs. sulph. magnesia, 3½ cwts. superphosphate of lime, and 200 lbs. ammonia-salts (in spring)	2322	39·1	59·4	30	0	13
6	200 lbs. sulph. potash, 100 lbs. sulph. soda, 100 lbs. sulph. magnesia, 3½ cwts. superphosphate of lime, and 275 lbs. nitrate of soda (in spring)	2711	45·2	60	36	3	19
7	Unmanured	1495	25	59·6	19	3	13
8	200 lbs. sulph. potash, 100 lbs. sulph. soda, 100 lbs. sulph. magnesia, 3½ cwts. superphosphate of lime, and 400 lbs. ammonia-salts (in spring)	2616	43·6	60	36	3	19
9	200 lbs. sulph. potash, 100 lbs. sulph. soda, 100 lbs. sulph. magnesia, 3½ cwts. superphosphate of lime, and 550 lbs. nitrate of soda (in spring)	2910	48·7	59·7	38	3	5
10	Farmyard-manure, estimated to contain nitrogen = 100 lbs. ammonia, made from 640 lbs. decorticated cotton-cake, 1024 lbs. maize-meal, 7680 lbs. cabbages, 1280 lbs. wheat-straw, as food; and 1664 lbs. wheat-straw as litter. Weight about 4 tons	1991	33·2	60	24	3	13
11	Farmyard-manure, estimated to contain nitrogen = 200 lbs. ammonia, made from 1280 lbs. decorticated cotton-cake, 2048 lbs. maize-meal, 15,360 lbs. cabbages, 2560 lbs. wheat-straw chaff, as food; and 3328 lbs. wheat-straw as litter. Weight about 8 tons ..	2472	41·2	60	32	3	8

In 1879, on the contrary, the wheat was sown as late as the 15th of November, and cold weather having set in, the wheat was fully two months and a half in the ground before it got through the surface; and as the summer of 1880 was wet and cold, the wheat got blighted, did not ripen properly, and in consequence yielded a miserable produce.

Thus one of the two unmanured plots in 1880 yielded only 9½ bushels of wheat, weighing as little as 50 lbs. per bushel, and the second unmanured plot 14 bushels, weighing only 49 lbs. per bushel; whereas in 1881 the former plot produced 25½ bushels (in round numbers), weighing 57¼ lbs. per bushel, and the latter 25 bushels, weighing 59·6 lbs. per bushel.

It is a remarkable fact, that a light soil, like that of the experimental field, after having grown five crops of wheat in succession, produced 25 bushels of good wheat in the sixth season, without any manure. This favourable result, I cannot help thinking, is largely due to the fact that the wheat-crop of 1881 was sown early in autumn. The wheat came up well, and kept on steadily growing without a check, and had arrived at maturity in the beginning of August, when a good deal of later-sown wheat was still unfit for harvesting, and was subsequently spoiled by the continuous rain and cold weather which prevailed towards the end and beginning of September. The purely mineral-manures on plot 4 raised the produce only 3 bushels above that of the unmanured plots 1 and 7, whereas on plot 2 ammonia-salts alone gave an increase of about 6½ bushels, and nitrate of soda alone on plot 3 yielded an increase of 16 bushels over the unmanured wheat.

The heaviest crop, it will be seen, was produced on plot 9, manured with minerals and a heavy spring-dressing of nitrate of soda. This plot produced 47·8 bushels of wheat, weighing nearly 60 lbs. per bushel, and 1 ton 18 cwt. 3 qrs. and 5 lbs. of strong and clean straw.

The same quantity of minerals and only half the quantity of nitrate of soda on plot 6 produced 45·2 bushels, weighing 60 lbs. per bushel, and 1 ton 16 cwts. 3 qrs. and 19 lbs. of straw, or only 3½ bushels less of wheat than was obtained with double the amount of nitrate of soda applied on plot 9.

Neither excessively large doses of nitrate of soda nor of ammonia-salts, like the quantities used in these experiments, produce anything like so beneficial an effect as moderate quantities of nitrate of soda or ammoniacal top-dressings. Nitrate of soda, applied alone or in conjunction with mineral manures, produced better crops of wheat than ammonia-salts alone, or the mixed mineral and ammoniacal manures.

Farmyard-manure, even when used in the moderate quantity

of 4 tons per acre, had a very good effect on the permanent wheat in 1881.

On plot 10, manured with 4 tons of good dung, the produce amounted to 33·2 bushels, weighing 60 lbs. per bushel, and 24 cwt. 3 qrs. and 13 lbs. of straw; whereas in 1880 the produce of this plot amounted to only 15·1 bushels, weighing 50½ lbs. pei bushel, and 19 cwts. 2 qrs. and 3 lbs. of straw.

Double the quantity, that is 8 tons, of farmyard-manure per acre on plot 11, produced 41·2 bushels, weighing 60 lbs. per bushel, and 1 ton 12 cwts. 3 qrs. and 8 lbs. of straw; the yield on the same plot in the preceding year having been only 19¾ bushels, weighing only 51 lbs. per bushel, and 1 ton 5 cwts. 2 qrs. and 2 lbs. of straw.

On plot 6, manured with minerals and about 2½ cwts. of nitrate of soda, the produce in corn amounted to 45·2 bushels, weighing 60 lbs. per bushel, and 1 ton 16 cwts. 3 qrs. and 19 lbs. of straw: whilst on plot 8, manured with the same minerals and ammonia-salts, containing twice as much nitrogen as, in round numbers, the nitrate of soda used on plot 6, 2½ bushels less wheat were obtained, and no more straw than on plot 6.

Without exception the 11 plots produced in 1881 much more wheat, in some instances more than twice the weight of wheat, and corn of a much better quality than in the preceding year.

In every instance the application of nitrate of soda in 1881 had a better result than the corresponding experiments with ammonia-salts. The opposite was the case in the preceding year, when salts of ammonia, either applied alone, or in conjunction with mineral manures, in every instance gave a better yield of wheat than the corresponding experiments in which the salts of ammonia were replaced by nitrate of soda.

We have here striking examples presented to us of the danger of drawing general conclusions from the harvest-results of a single season. Notwithstanding the numerous experiments which have been made by many experimenters in which nitrate of soda and ammonia-salts have been applied to the wheat-crop, we have yet to learn the precise conditions under which either nitrate of soda or salts of ammonia produce the larger wheat-crop.

The Experiments on the Continuous Growth of Barley.

The minerals were sown broadcast on the 12th of March, 1881.

The dung, estimated to contain nitrogen equal to 100 lbs. of ammonia per acre on plot 10, and 200 lbs. of ammonia per acre on plot 11, was put on the land in a well-rotted condition on the 10th of January, 1881.

The nitrate of soda and salts of ammonia were applied on the 2nd of May.

The barley—Chevalier barley—was drilled in on the 11th of April at the rate of 9 pecks per acre, and appeared above ground on the 21st of April.

Three bullocks, which made the dung, when put into the feeding-boxes on the 10th of October, 1880, weighed—

	cwts.	qrs.	lbs.
No. 1.	10	3	13
„ 2.	12	1	13
„ 3.	12	0	20
Total weight of three bullocks on the 20th Oct. 1880 ..	35	1	18

The bullocks in the course of 5 weeks consumed—

Decorticated cotton-cake	5 cwts.
Maize-meal	8 cwts.
Cattle cabbages	3 tons.
Wheat-straw chaff	10 cwts.

And they were supplied during that period with 13 cwts. of wheat-straw, cut into chaff from 2 to 3 inches long, used as litter.

The dung was removed from the feeding-boxes on the 26th of November, placed into a covered hovel, and allowed to rot until the 10th of January, when it was weighed.

With the consumption of the above-named quantities of food and wheat-straw chaff used as litter, the three bullocks produced 2 tons 11 cwts. 2 qrs. and 8 lbs. of rotten dung.

On the 22nd of November, 1880, when the bullocks were removed from the feeding-boxes, their weight was as follows:—

	cwts.	qrs.	lbs.	Gain in Live-weight from Oct. 20 to Nov. 22, 1880 (5 weeks). cwts.	qrs.	lbs.	
No. 1. bullock	11	0	22	0	1	9	Total gain in 5 weeks: 1 cwt. 3 qrs. 21 lbs.
„ 2. „	13	0	7	0	2	22	
„ 3. „	13	0	10	0	3	18	
Total weight of three bullocks on the 22nd Nov.	37	1	11				

The three bullocks accordingly increased in weight at the rate of $43\frac{2}{5}$ lbs. per week, or each bullock gained about $14\frac{1}{2}$ lbs. per week, or 2 lbs. per day.

The barley was cut on the 1st and 2nd of September, and stacked on the same days. It was threshed out in the field on the 13th of October, 1881, and the straw weighed at the time of threshing; the corn was weighed and measured on the 20th of October, when the results embodied in the following Table were obtained:—

TABLE II.—PRODUCE OF CONTINUOUS BARLEY. FIFTH SEASON, 1881.

Plots.	Manures per Acre.	Produce per Acre.					
		Dressed Corn.			Straw, Chaff, &c.		
		Weight.	Number of Bushels.	Weight per Bushel.			
		lbs.		lbs.	cwts.	qrs.	lbs.
1	Unmanured	1677	34·1	49·2	16	0	11
2	200 lbs. ammonia-salts, alone	2230	44·5	50·1	21	0	22
3	275 lbs. nitrate of soda, alone	2429	49·5	49·1	24	1	22
4	200 lbs. sulphate of potash, 100 lbs. sulph. of soda, 100 lbs. sulph. magnesia, 3½ cwts. superphosphate of lime	1628	33·6	48·5	14	1	10
5	200 lbs. sulph. of potash, 100 lbs. sulph. of soda, 100 lbs. sulph. of magnesia, 3½ cwts. superphosphate of lime, and 200 lbs. ammonia-salts	2284	45·7	50	22	3	26
6	200 lbs. sulph. of potash, 100 lbs. sulph. of soda, 100 lbs. sulphate of magnesia, 3½ cwts. of superphosphate of lime, and 275 lbs. nitrate of soda	2677	53·3	50·2	29	1	10
7	Unmanured	1611	33·2	48·6	14	2	11
8	200 lbs. sulph. of potash, 100 lbs. sulph. of soda, 100 lbs. sulph. of magnesia, 3½ cwts. of superphosphate of lime, and 400 lbs. ammonia-salts	2672	53·1	50·3	27	2	13
9	200 lbs. sulph. of potash, 100 lbs. sulph. of soda, 100 lbs. sulph. of magnesia, 3½ cwts. of superphosphate of lime, and 550 lbs. of nitrate of soda	2842	56 8	50	31	0	12
10	Farmyard-manure, estimated to contain nitrogen = 100 lbs. of ammonia, made from 640 lbs. decorticated cotton-cake, 1024 lbs. maize-meal, 7680 lbs. cabbages, 1230 lbs. wheat-straw chaff, as food; and 1664 lbs. wheat-straw as litter. Weight about 4 tons	2255	44·8	50·3	23	1	26
11	Farmyard-manure, estimated to contain nitrogen = 200 lbs. ammonia, made from 1280 lbs. decorticated cotton-cake, 2048 lbs. maize-meal, 15,360 lbs. cabbages, 2560 lbs. wheat-straw chaff, as food; and 3328 lbs. wheat-straw as litter. Weight about 8 tons ..	2649	50·7	52·3	28	0	11

The results obtained in 1881 on the field upon which barley has been grown in succession for 5 years, on the whole, are confirmed by those obtained previously.

On most of the plots the barley did not weigh quite so much per bushel as in the preceding year, but the yield in corn and straw was greater. One of the unmanured plots (No. 7) produced a little less corn than the second unmanured plot (No. 1), which produced 34 bushels of somewhat light barley, and 16 cwts. and 11 lbs. of straw per acre.

The mineral manures on plot 4 had no effect whatever on the barley-crop in 1881. This plot, it will be seen, yielded almost exactly the same weight of corn and straw as the unmanured plot No. 7.

It will further be seen from the tabulated results that nitrate of soda alone applied as a top-dressing in spring at the rate of 2½ cwts. per acre gave an increase of about 16 bushels of corn, nearly 10 cwts. of straw, over the produce of the unmanured plot, No. 7.

Ammonia-salts alone also gave a considerable increase; but although on plot 2 the same amount of nitrogen was used in the shape of ammonia-salts, which on plot 3 was put on the land in the form of nitrate of soda, the ammonia-salts on plot 2 produced 5 bushels less corn and 3 cwts. 1 qr. less straw than the nitrate of soda on plot 3. Similar results were obtained in the preceding year, when nitrate of soda on plot 2 gave 5 bushels more corn and 5 cwts. 1 qr. more straw than the ammonia-salts on plot 2.

The addition of superphosphate of lime and other minerals to nitrate of soda or ammonia-salts had a most beneficial effect, as may be seen by comparing the produce of plots 5, 6, 8, and 9. In this combination nitrate of soda has had a much better effect than ammonia-salts.

Comparing the produce of plot 6, manured with minerals and top-dressed in spring with 2½ cwts. of nitrate of soda, containing as much nitrogen as 200 lbs. of ammonia-salts, with that of plot 8, manured with the same amount of minerals and 400 lbs. of ammonia-salts, containing twice as much nitrogen as the nitrate of soda used on plot 6, it will be seen that the smaller proportion of nitrogen applied in the form of nitrate gave fully as much corn and rather more straw than the larger dose of nitrogen applied to the land in the shape of salts of ammonia.

On plot 9, top-dressed with twice as much nitrate of soda as plot 6, a further increase both in corn and straw was obtained, but this increase was not commensurate with the additional application of 2½ cwts. of nitrate of soda.

$2\frac{1}{2}$ cwts. of nitrate of soda, without minerals, gave an increase of 16 bushels of barley and 10 cwts. and 1 qr. of straw above the produce of the unmanured plot No. 7.

The same quantity of nitrate of soda, in conjunction with superphosphate and other minerals, on plot 6 produced 20 bushels more barley and 14 cwts. 3 qrs. more straw than was obtained on the unmanured plot No. 7; and 5 cwts. of nitrate of soda (in round numbers), in conjunction with the same proportion of mineral manures which were applied to plot 6, gave an increase of $23\frac{1}{2}$ bushels of corn and $16\frac{1}{2}$ cwts. of straw above the produce of plot 7, or only $3\frac{1}{2}$ bushels more barley and not quite 2 cwts. more straw than was produced by half the quantity of nitrate of soda used on plot 6.

The practical conclusion that may be legitimately drawn from these experiments with nitrate of soda and minerals is, I think, that in practice moderate applications of nitrate of soda, in conjunction with mineral manures (superphosphate), to the barley-crop pay better for the outlay than very large dressings of nitrate of soda.

In the preceding year the produce of barley on plot 9, manured with minerals and 5 cwts. of nitrate of soda, amounted to only $44\frac{1}{2}$ bushels, or to 12 bushels less than in 1881. On the other hand, the straw grown with the $44\frac{1}{2}$ bushels of barley in 1880 weighed 36 cwts. and 20 lbs., whereas on the same plot $56\frac{1}{2}$ bushels of barley were reaped in 1881, and only 31 cwts. and 12 lbs. straw, or 5 cwts. and 8 lbs. less straw than in the preceding year. This shows that in cold seasons, like that of 1880, the effect of large doses of nitrate of soda to barley appears to be to produce rather abundance of straw than good barley. In cold and wet seasons a small dressing of nitrate of soda often produces more corn than a large dressing.

Thus, in 1880, mineral manures and $2\frac{1}{2}$ cwts. of nitrate of soda actually produced $4\frac{3}{10}$ bushels more barley, weighing $2\frac{2}{10}$ lbs. more per bushel, than the same quantity of minerals and 5 cwts. of nitrate of soda.

It will also be seen that the dung on plots 10 and 11 had a very good effect upon the barley-crop in 1881. The smaller dressing—about 4 tons on plot 10—produced nearly 45 bushels, weighing 50·3 lbs. per bushel, and 23 cwts. 1 qr. and 26 lbs. of straw, and the larger dose (about 8 tons of dung) on plot 11 produced nearly 51 bushels of corn and 28 cwts. and 11 lbs. of straw. The barley on plot 11 weighed 52·3 lbs. per bushel, or from 2 to $3\frac{1}{2}$ lbs. more per bushel than the barley on the other experimental plots.

The Experiments in Rotation.

Rotation No. 1.—1877, seeds; 1878, wheat; 1879, mangolds; 1880, barley.

Seeds, 1881.—The 4 acres in Rotation No. 1, having grown a good crop of broad clover and rye-grass in 1877, it was considered desirable not to run the risk of failure by growing broad or red clover after the short interval of three years. Accordingly, white Dutch clover was sown between the barley-crop of 1880, and a capital plant was obtained, which stood the winter well and grew luxuriantly in spring.

The clover was fed-off by sheep in the course of the growing season. On one acre, 672 lbs. of decorticated cotton-cake were consumed; on the second acre, 728 lbs. of Indian-cornmeal; and the third and fourth acres were separately eaten off without any purchased food.

On each of the four acres ten sheep were put on the 23rd of May, 1881. The clover was in good condition for stocking, and white with flowers.

The sheep were weighed on the 23rd of May, before they were put on the clover, and again on the 16th of June, when they were clipped. They were supplied with fresh water in the fields. The following results were obtained:—

Plots.		Increase in Live-weight without Wool. lbs.
1.	Fed-off by 10 sheep, each sheep receiving about ½ lb. decorticated cotton-cake per day; 10 sheep on the land 24 days	99¾
2.	Fed-off by 10 sheep, each sheep consuming about ½ lb. maize-meal; 10 sheep on the land 24 days	99½
3.	Fed-off by 10 sheep, without other food; 10 sheep on the land 24 days	125¾
4.	Fed-off by 10 sheep, without other food; 10 sheep on the land 24 days	126¾

It will be seen that the sheep fed upon the cotton-cake increased to the same extent as those fed upon maize-meal as additional food, and that both lots did not do so well as the sheep which had no additional food. It is curious that the two lots fed upon clover only increased at the same rate, and the two lots fed upon cotton-cake and maize made almost exactly the same progress. The clover towards the 8th of June was abundant on all four acres, very sweet and the seed having been just begun to be well-set by that time. The sheep evidently relished the fine Dutch clover more than the dry additional food, and did better upon the well-ripened Dutch clover, which

is well-known to be a food possessing a high feeding-value when arrived at perfection, that is, the period when it has just done flowering, and the seed has begun to set in the flowering-heads.

The sheep were clipped on the 16th of June:—

The ten sheep on plot 1 produced 65½ lbs. of wool, and made a total increase of 1 cwt. 1 qr. 27¼ lbs.

The ten sheep on plot 2 produced 69 lbs. of wool, and made a total increase of 1 cwt. 2 qrs. ½ lb.

The ten sheep on plot 3 produced 68 lbs. of wool, and made a total increase of 1 cwt. 2 qrs. 25¾ lbs.

The ten sheep on plot 4 produced 67½ lbs. of wool, and made a total increase of 1 cwt. 2 qrs. 26¼ lbs.

In feeding down the clover each lot of ten sheep was confined within hurdles, in pens affording a day's supply of green food. By shifting the hurdles daily, loss of food by trampling was avoided as much as possible.

By the 1st of July the sheep had gone once over the clover. They were then weighed, with the following results:—

Plots.		Increase or decrease in Live-weight since June 16, 1881. lbs.
1.	Fed-off by 10 sheep, eating about ½ lb. of cotton-cake; on land 38 days	+ 75¼
2.	Fed-off by 10 sheep, eating about ½ lb. of maize-meal; on land 38 days	+ 65
3.	Fed-off by 10 sheep, without other food; on land 38 days	− 14
4.	Fed-off by 10 sheep, without other food; on land 38 days	− 3¾

During the first twenty-four days the sheep fed upon clover alone increased more in weight than the pens which received cotton-cake or maize-meal. In the next fortnight, on the contrary, the sheep having as additional food decorticated cotton-cake did best; next came those fed upon maize. Both these pens increased considerably in weight between June 16th and July 1st, whilst the sheep on plot 3, fed without additional food, in the same period lost 14 lbs., and those on plot 4, also fed on clover only, lost 3¾ lbs. The explanation of these differences in the increase of the sheep is, that as the season advanced, the clover got rather hard, and a good deal was not properly cleared up, but was trodden under foot by the sheep, so that the sheep on plot 1, which received about 1½ lb. each of decorticated cotton-cake, and those on plot 2, which had given them about ½ lb. of maize-meal, showed the benefit of the additional food.

The sheep were put again on the clover on the 2nd of July,

1881, and in twenty-four days had finished the clover, having gone over the field twice by the 26th of July, when they were weighed, and the following results obtained:—

Plots.		Increase in Live-weight since July 2, 1881. lbs.
1.	Fed-off by 10 sheep, eating about ½ lb. of decorticated cotton-cake per day; on land 24 days	182¾
2.	Fed-off by 10 sheep, eating about ½ lb. of maize-meal per head per day; on land 24 days ..	138
3.	Fed-off by 10 sheep, without additional food; on land 24 days	66
4.	Fed-off by 10 sheep, without additional food; on land 24 days	89

The sheep fed upon decorticated cotton-cake, it will be seen, did remarkably well. The pen fed upon maize-meal did not make so large an increase, but they made more flesh than the sheep on plots 3 and 4, which received neither cake nor corn. Towards the end of July the clover got very short, and I was surprised to find the sheep getting on as well as they did on a somewhat scanty supply of green food.

By the middle of September there was again a good bite of clover on the four rotation clover-fields. On the 14th of September, ten sheep were again put on each acre, after having been carefully weighed. The clover was not so sweet as earlier in the season, and the sheep did not eat it down so closely as they did in going over the clover for the first and second times.

The sheep on plots 1 and 2 finished the clover on the 5th of October, and those on plots 3 and 4 on the 1st of October.

When put on the field on the 14th of September, 1881—

	cwts.	qrs.	lbs.
The 10 sheep on plot 1 weighed	12	0	19
" " 2 "	12	3	4
" " 3 "	12	0	24¼
" " 4 "	12	0	5½

The sheep on plots 3 and 4 were weighed on the 1st of October, and those on plots 1 and 2 on the 5th of October, and weighed with the following results:—

Plots.		Increase + or decrease − lbs.
1.	10 sheep, eating decorticated cotton-cake; on land 21 days	+ 76
2.	10 sheep, eating maize-meal; on land 21 days	+48¾
3.	10 sheep, without additional food; on land 17 days	− 44¼
4.	10 sheep, without additional food; on land 17 days	− 41¼

The following Table gives a summary of the results, and

shows the number of sheep fed on each acre, the quantity of purchased food consumed (if any), the number of days the animals were kept on the land, and the total increase in live-weight yielded—

Plots.		Increase in Live-weight. lbs.
1.	Fed-off by 10 sheep, with 672 lbs. decorticated cotton-cake; on land 83 days	$433\frac{3}{4}$
2.	Fed-off by 10 sheep, with 728 lbs. of maize-meal; on land 83 days	$351\frac{1}{4}$
3.	Fed-off by 10 sheep, without other food; on land 79 days	$133\frac{1}{2}$
4.	Fed-off by 10 sheep, without other food; on land 79 days	$167\frac{3}{4}$

These experiments, it may be well to bear in mind, were solely made for the purpose of consuming the clover on the land, and to incorporate with a portion of the experimental field the manurial constituents of a definite quantity of decorticated cotton-cake, a food rich in nitrogen, and with another part those of a fixed quantity of Indian-cornmeal, a food poor in nitrogen. But although their object was not to experiment on the best mode of fattening sheep on clover, they nevertheless incidentally reveal a few facts of more or less interest and value to feeders of stock.

In the first place, I would observe, the periodical weighings of the forty sheep on the clover-field clearly show the impolicy of keeping stock on too scanty an allowance of food, and, in the second place, they show the superiority of decorticated cotton-cake as a food for sheep when it is given to them judiciously. Sheep fed upon cotton-cake and grass or clover, I may say in passing, should always be supplied with fresh water.

The sheep which consumed about $\frac{1}{2}$ lb. of decorticated cotton-cake, it will have been seen, increased in weight to a greater extent than those fed upon a similar allowance of maize-meal, and did remarkably well; for the ten sheep on plot 1 gained in weight $433\frac{3}{4}$ lbs. in eighty-three days, not taking into account the clipped wool, whilst in the same period the ten sheep fed upon maize-meal as an additional food made only $351\frac{1}{4}$ lbs., by no means a bad increase, but still not nearly so good a one as that gained by the consumption of decorticated cotton-cake. By the consumption of about $\frac{1}{2}$ lb. of decorticated cotton-cake, and as much white clover as they would eat, the sheep increased on an average of rather more than $\frac{1}{2}$ lb. per head per day.

There can therefore be no doubt that the consumption of decorticated cotton-cake on the land, whilst it greatly enriches

the land under favourable conditions, abundantly repays the cost of the cake in the increased production of animal food.

Rotation No. 2.—Four acres: 1877, mangolds; 1878, barley; 1879, seeds; 1880, wheat. Again mangolds in 1881.

The dung for the rotation mangolds was made by eight bullocks, two of which, in addition to mangolds and straw-chaff, consumed 1000 lbs. of decorticated cotton-cake, two others 1000 lbs. of maize-meal as an additional food; the four remaining bullocks were fed upon mangolds and straw-chaff only. The dung, which was in a fairly rotten state, was put on plots 1 and 2 on the 2nd of May; the mineral manures on plots 3 and 4 were sown on the 9th of May, and the nitrate of soda was sown around the mangolds on the 5th of July, after they had been singled and been well established on the soil.

The mangold-seed—Gibbs's improved Orange Globe—was drilled in on the 14th of May, and came up well. A few gaps in the drills were filled up by transplanting, which, being done when the soil was in a moist condition, succeeded perfectly well, and a beautifully regular plant was obtained on all four acres.

Between the 25th and 28th of October the roots were taken up, topped and tailed, and the whole produce of the four acres, bulbs and tops, were weighed on the 31st of October, when the results shown in the Table on next page were obtained.

A glance at this tabular statement shows that the heaviest crop was obtained on plot 3, manured with mineral manures equivalent to the mineral fertilising constituents in 1000 lbs. of decorticated cotton-cake, and two-thirds of the nitrogen in that quantity of cake.

The cotton-cake-dung applied to plot 1 produced the next best crop, and in the two remaining plots the difference in the weight of the roots was but trifling.

Altogether the mangold-crop in 1881 was very satisfactory on all four acres.

Rotation No. 3.—1878, seeds; 1879, wheat; 1880, roots; 1881, barley.

Barley, 1881.—The mangolds grown in 1880, were fed-off on the field by sheep early in spring; the land was ploughed in the beginning of April, and the barley drilled in on the 21st of April. Dutch clover-seed was sown between the barley on the 26th of May.

No manure was applied to plots 1, 2, and 4. On plot 3 the barley was top-dressed on the 27th of May with 124 lbs. of nitrate of soda, containing one-third as much nitrogen as the manure found in 1000 lbs. of decorticated cotton-cake.

TABLE III.—PRODUCE OF MANGOLDS, 1881 (ROTATION, No. 2), AFTER WHEAT.

Plots of One Acre.		Produce per Acre. Roots.				Leaves.			
		tons.	cwt.	qrs.	lbs.	tons.	cwt.	qrs.	lbs.
1	With dung, made from 1350 lbs. straw as litter; 5000 lbs. mangolds; 1250 lbs. wheat-straw chaff, and 1000 lbs. decorticated cotton-cake	22	5	0	23	3	12	2	24
2	With dung, made from 1350 lbs. straw as litter; 5000 lbs. mangolds; 1250 lbs. wheat-straw chaff, and 1000 lbs. of maize-meal	21	14	0	17	3	12	0	15
3	With dung, made from 1350 lbs. straw as litter; 5000 lbs. mangolds; 1250 lbs. wheat-straw chaff; and artificial manure, containing two-thirds as much nitrogen, and the other constituents, of the manure from 1000 lbs. decorticated cotton-cake; namely, 248 lbs. nitrate of soda, 100 lbs. of bone-ash (made into superphosphate), 62½ lbs. sulphate of potash and 65 lbs. sulphate of magnesia	24	7	0	18	4	0	3	25
4	With dung, made from 1350 lbs. straw as litter; 5000 lbs. mangolds; 1250 lbs. wheat-straw chaff; and artificial manure, containing as much nitrogen, and other constituents, as the manure from 1000 lbs. maize-meal; namely, 80 lbs. nitrate of soda, 16¼ lbs. bone-ash (made into superphosphate), 7 lbs. sulphate of potash, and 11 lbs. sulphate of magnesia	21	13	2	0	3	16	0	6

Owing to dry weather the barley came up rather unevenly, but the plant filled up well subsequently after a good shower of rain.

The barley was cut on plots 2, 3, and 4 on the 31st of August, on plot 1 on the 1st of September, and threshed on the 12th of October, when the straw and chaff were weighed in the field, and the corn kept in labelled bags in the granary. It was winnowed, weighed, and measured, on the 20th of October, 1881, and the results embodied in the Table opposite were obtained.

It will be seen that a good crop of barley was produced on all the four acres, and that the produce in corn showed only small differences on the several plots. The barley weighed from

TABLE IV.—PRODUCE OF BARLEY (ROTATION NO. 3), IN 1881, AFTER MANGOLDS FED ON THE LAND.

Plots of One Acre.		Dressed Corn.						Straw, Chaff, &c.
		Head-Corn.			Tail-Corn.			
		Weight.	Bushels.	Weight per Bushel.	Weight.	Bushels.	Weight per Bushel.	
		cwts. qrs. lbs.		lbs.	cwts. qrs. lbs.		lbs.	tons. cwts. qrs. lbs.
1	Without artificials (cotton-cake plot) ..	20 3 $1\frac{1}{4}$	46·5	50	1 3 5	4·1	47·5	1 8 0 17
2	Without artificials (maize plot)	20 3 6	46	50·6	0 2 $4\frac{1}{2}$	1·3	$44\frac{3}{4}$	1 6 3 27
3	With artificial manure, containing one-third as much nitrogen as the manure from 1000 lbs. decorticated cotton-cake, namely, 124 lbs. nitrate of soda	20 3 17	46·8	50	1 3 0	4·2	47	1 9 0 8
4	Without artificial manure	21 1 $17\frac{3}{4}$	47·5	50·5	1 1 $22\frac{3}{4}$	3·5	47	1 5 3 2

1 to 2 lbs. less per bushel than the barley in Rotation No. 1 in the preceding year. On plot 3, top-dressed with nitrate of soda, the greatest weight of straw was produced, and on plot 1 (cotton-cake plot) also more straw, but not more corn than on the two remaining plots was obtained.

Rotation No. 4.—Four acres; 1878, mangolds; 1879, barley; 1880, seeds; 1881, wheat.

Wheat, 1881.—The seeds were fed in 1880 by sheep, which were taken off the land on the 1st of October, when it was ploughed up and got ready for wheat-sowing. Browick wheat, at the rate of 8 pecks per acre, was drilled on the 21st of October, 1880. The mineral manures were sown on the 26th of February, 1881, and the nitrate of soda was applied as a top-dressing on the 30th of March, 1881. The wheat was well above ground on the 11th of November. It was cut on the 10th of August, stacked on the 20th of August, and threshed out in the field on the 11th of October. The straw and chaff were weighed in the field at the time of threshing, and the corn was kept in labelled bags in the granary until the 19th of October, and weighed and measured on the 19th and 20th of October, when the results shown in the Table opposite were obtained.

The wheat-crop on all four acres was strong and luxuriant throughout the season.

In plots 3 and 4, especially plot 3, dressed with the larger amount of nitrate of soda, the colour was darker green in spring than on the two other plots, and towards harvest the straw appeared somewhat stronger on plots 3 and 4, than on the two remaining acres.

On all four acres the straw was very strong and healthy, and the actual weighings when the wheat was threshed out showed that on plot 3, dressed with the large dose of nitrate of soda, 6 cwts. more straw was obtained than on the cotton-cake and maize plots; and on plot 4, top-dressed with the smaller proportion of nitrate of soda, about 6 cwts. more straw was produced than on plots 1 and 2.

The differences in the yield of corn on the four acres, it will be noticed, were but trifling. The quality of the wheat was good; on three of the four acres it weighed 60 lbs. per bushel, and on plot 3, which gave the largest produce of straw, and a little more corn, the wheat weighed 59½ lbs. per bushel.

Taking head and tail wheat together,

Plot 1 produced 56·4 bushels of wheat.
„ 2 „ 57·4 „
„ 3 „ 58·9 „
„ 4 „ 55·8 „

In 1880 the wheat crop on Rotation No. 2, in the same field,

TABLE V.—PRODUCE OF WHEAT (ROTATION NO. 4), IN 1881, AFTER SEEDS FED ON THE LAND IN 1880.

Plots of One Acre.		Dressed Corn.						Straw, Chaff, &c.
		Head-Wheat.			Tail-Wheat.			
		Weight.	Bushels.	Weight per Bushel.	Weight.	Bushels.	Weight per Bushel.	
		cwts. qrs. lbs.		lbs.	cwts. qrs. lbs.		lbs.	tons. cwts. qrs. lbs.
1	Seeds fed off by sheep, which consumed 672 lbs. of decorticated cotton-cake ..	29 1 1	54·6	60	0 2 20½	1·8	51¾	2 2 0 0
2	Seeds fed off by sheep, which consumed 728 lbs. of maize-meal	29 2 1½	55	60	1 1 0	2·4	57¼	2 2 0 17
3	Seeds fed off by sheep without cake or corn, top-dressed in spring with artificial manures, containing as much nitrogen, potash, phosphoric acid, &c., as 672 lbs. of decorticated cotton-cake	29 3 26	56·4	59½	1 0 13	2·5	51½	2 8 2 18⅓
4	Fed off by sheep without cake or corn, top-dressed in spring with artificial manures, containing as much fertilising matter as the dung from 728 lbs. of maize-meal ..	28 3 13	53·9	60	0 2 5	1·4	44	2 6 1 23¾

manured and otherwise treated exactly in the same way as the wheat in Rotation No. 4 in 1881, yielded on

Plot 1—21·2 bushels of head-wheat, weighing only 51 lbs., per bushel, and 1·5 bushels of tail-wheat.

Plot 2—24·1 bushels of head-wheat, weighing 51 lbs. per bushel, and 2·1 bushels of tail-wheat.

Plot 3—20 bushels of head-wheat, weighing 51 lbs. per bushel, and 1·9 bushels of tail-wheat.

Plot 4—23·5 bushels of head-wheat, weighing 51·8 lbs. per bushel, and 1·6 bushels of tail-wheat.

1880, it will be remembered, in many parts of the country turned out one of the worst corn-growing seasons which we have had for many years past. The weather was cold, and much rain fell towards harvest-time, and the wheat-crop had not a fair chance of properly ripening; the wheat in consequence yielded badly, and produced a miserable sample.

In 1881, on the contrary, we had fine and genial weather in the spring, and the early part of the summer, and we were fortunate enough to cut the wheat in a well-matured condition before the continuous rains towards the end of August set in, and in many places did serious injury to the corn-harvest.

The experimental field is by no means strong wheat-land, but rather a light good barley-soil. Nevertheless it yielded in 1881 fully 7 qrs. of good wheat, and over 2 tons of clean and fine straw. This successful result I am inclined to ascribe mainly to the more favourable season in comparison with the preceding one, and also to the fact that the wheat-crop of 1881 was sown a month earlier than in 1880, and in the beginning of November had made its appearance above ground; whilst in 1880 the seed remained under ground for more than 2½ months before it pushed through the soil. The wheat in 1881 thus had a start of fully three months over that of 1880, and this circumstance no doubt went far to explain the successful yield of the wheat-crop last year, and the failure of the preceding year.

XII.—*Field Experiments on Swedish Turnips with Soluble and finely ground Phosphatic Fertilisers.* By Dr. Augustus Voelcker, F.R.S.

In 1880 a number of experiments with various kinds of phosphatic manures were tried at Crawley Mill Farm, Woburn, in Warren-field, on rather retentive soil, containing more clay than any of the other fields at Crawley. It appeared to me desirable to try in 1881 similar experiments on some of our

light land, and for this purpose the Lansome-field, the only one which was available and at all suitable, was selected. In this field the varieties of wheat which were entered for the Society's prize-wheat competition were grown in the preceding year. The soil in this field is a light and deep sandy soil, containing but little lime and alumina, and a good deal of oxide of iron, especially in the subsoil.

Neither was the field as level nor as uniform in its general character as I could have wished. Taking the most level portion of the field towards the centre, 4 acres, exclusive of the pathway between each plot, were set aside for experimental purposes.

The land was very foul when it was taken in hand; but by dint of much labour in forking out couch-grass and killing surface-weeds, it was got quite clean, and there was an excellent seed-bed for the turnips when the seed was drilled in.

Each experimental plot occupied the space of a quarter of an acre, separated from the next by a path of 2½ feet in width, and there were altogether 16 quarter-acre plots.

The following Table shows the way in which the several quarter-acre plots were treated as regards manure, the cost of each kind of manure per ton, and the cost of the application per acre.

Plots.	Manures Used.	Quantity of Manure per Acre.	Cost of Manure per Ton.	Cost of Manure per Acre.
			£ s.	£ s. d.
1	No manure	..	..	..
2	Finely ground coprolites	5 cwts.	4 0	1 0 0
3	Dissolved coprolites	5 cwts.	4 0	1 0 0
4	Redonda phosphate (phosphate of alumina and iron)	5 cwts.	3 10	0 17 6
5	Precipitated phosphate of lime..	4 cwts.	5 0	1 0 0
6	Bone-meal (made from raw bones)	3 cwts.	7 10	1 2 6
7	Dissolved bones	3 cwts.	6 10	0 19 6
8	Dissolved coprolites .. .. .. and Peruvian guano	3 cwts. 2½ cwts.	4 0 12 10	12*s.* 0*d.* 31*s.* 3*d.* } 43*s.* 3*d.*

These experiments were made in duplicate.

It will be seen that in this scheme we have two kinds of finely ground phosphates, namely, ground coprolites, consisting mainly of phosphate of lime and some carbonate of lime; and Redonda phosphate, a mineral phosphate, consisting for the greater part of hydrated phosphate of alumina, with some phosphate of iron.

Both were reduced to an impalpable powder.

In precipitated phosphate of lime we have a phosphatic fertiliser in a more minutely divided condition than in finely ground coprolites or Redonda phosphate. Like these minerals, precipitated phosphate of lime, although derived from bone, practically speaking contains no organic matter or nitrogen in any form.

In bone-meal, insoluble phosphate of lime is associated with nitrogenous organic matter; and in dissolved bones, soluble phosphate of lime, with more or less insoluble phosphate of lime and gypsum, is associated with nitrogenous organic matter. The guano, bone-meal, dissolved bones, and precipitated phosphate of lime, used in 1881, were portions left over from last year's experiments; and having been kept in bags under cover, may be assumed to be of the same quality and composition as manures of the same name which were used in the swede experiments on Warren-field in the preceding year.

The ground coprolites, dissolved coprolites, and Redonda phosphate were taken from fresh supplies.

For ground coprolites we had to pay 16*s.* more per ton than in the preceding year; and for dissolved coprolites 10*s.* less, the price of both being 4*l.* per ton. The price of Redonda phosphate in 1880 was 2*l.* 2*s.* per ton, whereas in 1881 we had to give 3*l.* 10*s.* for it. The last supply, however, as will be seen from the appended analysis, was richer in phosphoric acid than the Redonda phosphate which we bought in the preceding year.

With the exception of the mixture of Peruvian guano and superphosphate, which was applied to plot 8 at an expense of 2*l.* 3*s.* 3*d.* per acre, the cost of the remaining fertilisers varied from 17*s.* 6*d.* to 22*s.* 6*d.* per acre. In most instances the cost of manures was 1*l.* per acre.

The diagram on the opposite page shows the arrangement of the 16 quarter-acre plots.

The artificial manures were applied to the land on the 10th and 11th of June, and the seed (Gibbs's Selected Purple-top Swedes) was drilled in on the 15th and 16th of June. The distance between the rows was 22 inches.

In the course of a few days the seed germinated, and in about three weeks the plants were big enough to be singled. There was a regular plant on all the 16 experimental plots.

The swedes manured with dissolved coprolites had slightly the start over the others.

On the 8th of August, when I inspected the swedes, those manured with dissolved coprolites were stronger than those on

WOBURN ROOT EXPERIMENTS in 1881 in LANSOME FIELD, CROP SWEDISH TURNIPS (GIBBS'S SELECTED PURPLE-TOP), each PLOT $\frac{1}{4}$ of an ACRE, separated from the rest by paths $2\frac{1}{2}$ feet in width.

No. 1. A.	No. 2. A.	No. 3. A.	No. 4. A.	No. 5. A.	No. 6. A.	No. 7. A.	No. 8. A.
No manure.	5 cwts. of ground coprolites per acre; cost, 1*l.* per acre.	5 cwts. of dissolved coprolites per acre; cost, 1*l.* per acre.	5 cwts. of Redonda phosphate per acre; cost, 17*s.* 6*d.* per acre.	4 cwts. of precipitated phosphate; cost, 1*l.* per acre.	3 cwts. of bone-meal per acre; cost, 22*s.* 6*d.* per acre.	3 cwts. of dissolved bones per acre; cost, 19*s.* 6*d.* per acre.	3 cwts. of dissolved coprolites and $2\frac{1}{4}$ cwts. of Peruvian guano per acre; cost, 43*s.* 3*d.* per acre.
No. 5. B.	**No. 6. B.**	**No. 7. B.**	**No. 8. B.**	**No. 1. B.**	**No. 2. B.**	**No. 3. B.**	**No. 4. B.**
4 cwts. of precipitated phosphate per acre; cost, 1*l.* per acre.	3 cwts. of bone-meal per acre; cost, 22*s.* 6*d.* per acre.	3 cwts. of dissolved bones per acre; cost, 19*s.* 6*d.* per acre.	3 cwts. of dissolved coprolites and $2\frac{1}{4}$ cwts. of Peruvian guano per acre; cost, 43*s.* 3*d.* per acre.	No manure.	5 cwts. of ground coprolites per acre; cost, 1*l.* per acre.	5 cwts. of dissolved coprolites per acre; cost, 1*l.* per acre.	5 cwts. of Redonda phosphate per acre; cost, 7*s.* 6*d.* per acre.

the plot manured with ground coprolites. Not much difference could be noticed between the roots manured with dissolved coprolites and those treated with dissolved bones. In plots 8 A and B (manured with guano and superphosphate) the swedes had larger tops than the rest.

With these exceptions there was very little perceptible difference in the appearance of the swedes on the several plots. On closer examination, however, I noticed that on the unmanured plot 1 in Section A, a good many swedes were attacked by anbury, and that in Section B, plot 5 (manured with precipitated phosphate of lime), many roots also were diseased and attacked by anbury.

The swedes grew steadily without a check throughout the summer, and were quite ripe by the 7th of October. They were pulled on the 7th of October and following days, topped and tailed, and the whole produce of each quarter-acre plot was weighed, the results incorporated in the following Table being obtained :—

TABLE I.—WEIGHT of TOPPED and TAILED SWEDES and of LEAVES grown on each EXPERIMENTAL QUARTER-ACRE PLOT in LANSOME FIELD, 1881.

		Roots.				Leaves.		
		tons.	cwts.	qrs.	lbs.	cwts.	qrs.	lbs.
Plot 1 A	No manure	4	12	2	25	11	3	27½
„ 1 B		5	3	1	8	11	3	5
Plot 2 A	Ground coprolites	6	10	0	19	11	1	13
„ 2 B		6	8	0	2	11	3	21
Plot 3 A	Dissolved coprolites	6	12	1	1	11	1	0
„ 3 B		7	1	2	11	11	2	6
Plot 4 A	Redonda phosphate	6	8	1	18	6	2	17
„ 4 B		6	18	1	15	9	2	0
Plot 5 A	Precipitated phosphate	5	12	3	5	11	0	16
„ 5 B		5	5	3	4		..	
Plot 6 A	Bone-meal	6	2	3	8	10	3	1
„ 6 B		6	8	0	26	9	2	11
Plot 7 A	Dissolved bones	6	13	0	7	12	2	10
„ 7 B		6	14	0	10	11	0	16
Plot 8 A	Superphosphate and Peruvian guano	6	9	2	23	13	1	17
„ 8 B		7	0	2	15	13	3	8

The next Table shows the weight of topped and tailed swedes, and the weight of leaves of each plot calculated per acre, the average produce of the duplicate plots per acre, the increase of each plot per acre over the average produce of the unmanured plots, the quantities and kinds of manure used, and the cost of the manure per acre.

On plot 5 B (manured with precipitated phosphate of lime), as stated already, a good many of the swedes were diseased, which partly explains the comparatively small crop on this plot. Moreover, this plot was on naturally weak ground, for it was the spot where in the preceding year the wheat stood very thin. The differences in the weight of the swedes in the duplicate experiments in some instances amount to over 3½ tons per acre, and in others to from 1 to 2 tons, roughly speaking. They are due, no doubt, to the unequal character of the soil in the experimental field, and not to any gaps in the rows; for the swedes on all plots were remarkably even, with hardly any blanks.

A careful inspection of the preceding tabulated results, amongst other particulars, shows :—

1. That the average produce of the two unmanured plots 1 A and 1 B amounted to 19 tons 12 cwts. and 10 lbs. of clean

TABLE II.—WEIGHT of TOPPED and TAILED SWEDES and of LEAVES calculated PER ACRE.

PLOTS.	MANURE USED, AND COST OF MANURE, PER ACRE.	Roots (topped and tailed) per Acre.				Leaves.				Average Produce of Roots of Duplicates per Acre.				Increase in Roots over Average Unmanured Plots per Acre.			
		tons.	cwts.	qrs.	lbs.	tons.	cwts.	qrs.	lbs.	tons.	cwts.	qrs.	lbs.	tons.	cwts.	qrs.	lbs.
1 A	No manure	18	10	3	16	2	5	3	26	19	12	0	10	..			
1 B		20	13	1	4	2	7	0	20								
2 A	5 cwts. of ground coprolites: cost, 1*l.* per acre	26	0	2	20	2	5	1	24	25	16	1	14	6	4	1	4
2 B		25	12	0	8	2	7	3	0								
3 A	5 cwts. of dissolved coprolites: cost, 1*l.* per acre ..	26	9	0	4	2	5	0	0	27	7	2	24	7	15	2	14
3 B		28	6	1	16	2	6	0	24								
4 A	5 cwts. of Redonda phosphate: cost, 17*s.* 6*d.* per acre	25	13	2	16	1	6	2	12	26	13	2	10	7	1	2	0
4 B		27	13	2	4	1	18	0	0								
5 A	4 cwts. of precipitated phosphate of lime; cost, 1*l.* per acre	22	11	0	20	2	4	2	8	21	17	0	18	2	5	0	8
5 B		21	3	0	16												
6 A	3 cwts. of bone-meal: cost, 22*s.* 6*d.* per acre	24	11	1	4	2	3	0	4	25	2	0	12	5	10	0	2
6 B		25	12	3	20	1	18	1	16								
7 A	3 cwts. dissolved bones: cost, 19*s.* 6*d.* per acre	26	12	1	0	2	10	1	12	26	14	1	6	7	2	0	24
7 B		26	16	1	12	2	4	2	8								
8 A	3 cwts. of dissolved coprolites and $2\frac{1}{2}$ cwts. of Peruvian guano: cost, 43*s.* 3*d.* per acre	25	18	3	8	2	13	2	12	27	0	2	20	7	8	2	10
8 B		28	2	2	4	2	15	1	4								

roots, which is a large produce, considering the light sandy character of the soil of the experimental field.

2. That 5 cwts. of dissolved coprolites per acre on an average produced 1 ton 11 cwts. 1 qr. and 10 lbs. more swedes than the same quantity of finely ground coprolites. The cost of the manure in both instances was 1*l.* per acre. The increase over the unmanured plots, due to the application of mineral superphosphate, amounted to 7 tons 5 cwts. 2 qrs. and 14 lbs.

It will be seen that no other manure, not even the mixture of superphosphate and Peruvian guano, costing rather more than twice as much as the dissolved coprolites applied to plot 3, produced so large an increase. On the light soil of Lansome-field, mineral superphosphate on plot 3 in Section A produced 27 tons 9 cwts. and 4 lbs. of clean swedes, topped and tailed; and on the duplicate plot 28 tons 6 cwts. 1 qr. and 16 lbs.; or an average of 27 tons 7 cwts. 2 qrs. and 24 lbs.

3. That finely ground coprolites on an average gave an increase of 6 tons 4 cwts. 1 qr. and 7 lbs. of clean swedes over the average yield of the two unmanured plots.

4. That Redonda phosphate (hydrated phosphate of alumina and iron) increased the swede-crop by 7 tons 1 cwt. 2 qrs. on an average. Redonda phosphate gave nearly 1 ton more roots than ground Cambridge coprolites.

5. That in these trials ground coprolites gave a larger increase than bone-meal, but less than dissolved bones.

6. That precipitated phosphate of lime in this year's experiments gave disappointing results. On plot 5 B, as stated already, many roots were attacked by anbury, which, no doubt, told on the weight of roots; but I do not see any reason why the produce on plot 5 in Section A was smaller than on any of the other manured plots. In similar trials in Warren-field precipitated phosphate of lime last year was used with very satisfactory results, and I cannot therefore explain the unsatisfactory effect of this phosphatic material upon the swede-crop in Lansome-field.

7. That the mixture of Peruvian guano and superphosphate had a less favourable effect upon the swede-crop on the light soil of Lansome-field than on the stronger soil of Warren-field in the preceding year.

It will be further noticed that the weight of leaves on plots A 8 and B 8 (manured with guano and superphosphate) was greater than on any of the remaining experimental plots.

The effect of the nitrogen in guano on the light soil of Lansome-field appears to have been to favour too much the production of large tops, without a corresponding advantage to the development of the bulbs.

I append analyses of the artificial manures which were used in these experiments.

Composition of a Sample of Peruvian Guano used in Swede Experiments at Woburn.

Moisture	19·10
*Organic matter and ammoniacal salts	36·65
Phosphate of lime	26·13
†Alkaline salts	13·32
Insoluble siliceous matter	4·80
	100·00
*Containing nitrogen	8·90
Equal to ammonia	10·81
†Containing phosphoric acid	4·42
Equal to tribasic phosphate of lime ..	9·65
Total percentage of phosphoric acid ..	16·39
Equal to tribasic phosphate of lime ..	35·78

The Guano was a superior genuine Peruvian Guano.

Composition of a Sample of finely ground Cambridge Coprolites used in the Swede Experiments at Woburn.

Water and a little organic matter	4·93
*Phosphoric acid	26·28
Lime	44·55
Oxide of iron, alumina, magnesia, fluorine, carbonic acid, &c.	17·42
Insoluble siliceous matter	6·82
	100·00
*Equal to tribasic phosphate of lime	57·37

Composition of a Sample of Dissolved Cambridge Coprolites used in the Swede Experiments at Woburn.

Moisture	8·96
Organic matter and water of combination ..	9·53
Monobasic phosphate of lime	17·80
Equal to tribasic phosphate of lime (bone phosphate) rendered soluble by acid	(27·87)
Insoluble phosphates	7·80
Sulphate of lime .. .. Alkaline salts and magnesia	49·46
Insoluble siliceous matter	6·45
	100·00

Composition of a Sample of fine Bone Meal used in the Swede Experiments at Woburn.

Moisture	9·01
*Organic matter	30·29
Phosphate of lime	51·15
Carbonate of lime, magnesia and alkaline salts	8·01
Insoluble siliceous matter	1·54
	100·00
*Containing nitrogen	3·54
Equal to ammonia	4·29

Composition of a Sample of Dissolved Bone Meal used in the Swede Experiments at Woburn.

Moisture	6·20
*Organic matter and water of combination	31·50
Monobasic phosphate of lime	14·72
Equal to tribasic phosphate of lime (bone phosphate) rendered soluble by acid	(23·05)
Insoluble phosphates	15·69
Sulphate of lime / Alkaline salts and magnesia	27·74
Insoluble siliceous matter	4·15
	100·00
*Containing nitrogen	2·52
Equal to ammonia	3·06

Composition of a Sample of Redonda Phosphate used in the Swede Experiments at Woburn.

Loss on heating	15·06
*Phosphoric acid	23·91
Lime	Traces
Oxide of iron and alumina	22·84
Insoluble siliceous matter	38·19
	100·00
*Equal to tribasic phosphate of lime	52·19

Composition of a Sample of Precipitated Phosphates from a Manufacturer of Glue in Cheshire, at 5l. per ton.

Moisture	28·75
Water of combination and a little organic matter	8·25
*Phosphoric acid	31·44
Lime	29·80
Magnesia, &c.	1·76
	100·00
*Equal to tribasic phosphate of lime	68·63

XIII.—*Experiments in Warren Field, Crawley-Mill Farm, Woburn, on the Manurial Value of various Phosphatic Fertilisers.* By Dr. AUGUSTUS VOELCKER, F.R.S., Consulting Chemist to the Royal Agricultural Society.

IN Part I. vol. xvii. of this 'Journal,' an account of experiments on Swedish turnips was given. These were instituted mainly for the purpose of testing experimentally, on a sufficiently extended scale, the comparative manuring properties of finely ground coprolites and other mineral phosphates and phosphatic

fertilisers, in which the phosphates for the greater part are actually soluble in water.

In order to save the reader the trouble of referring to this volume, the diagram on p. 330 has been transcribed, which will show at a glance the kinds and quantities of the manures which were employed in raising a crop of Swedish turnips on the 6 acres under experiment, and the general arrangement of the experimental plots, each plot occupying one-fourth of an acre.

The whole of the swede crop, varying in the different experiments from 18 tons to 26½ tons, in round numbers, was carted off the land in the autumn of 1880, and no further manure of any kind will be applied to any of the 24 quarter-acre plots in the course of the four years' ordinary rotation.

A good seed-bed having been procured by suitable cultivation, the barley was drilled in on the six acres on the 14th and 15th of April, 1881, and red clover-seed was drilled between the barley on the 28th of May.

In July the barley in Warren-field, on the end part of Section A farthest away from the roadway, looked rather thin on the dung-plots Nos. 8, 9, and 10. As far as could be judged, the barley was injured on those plots to the extent of about one-third. The injury was due partly to the damage done by wire-worms in the early part of the year, and partly to the circumstance that the land where the barley was damaged is rather low and had been flooded a good deal during the two previous years. The clover also did not look so healthy on these wet places as in other parts of the field. On the 2nd of August I took the following notes on the spot.

In Section A, plot 1 (ground coprolites), the barley was decidedly thinner and less luxuriant than on plot 2, manured with dissolved coprolites. On plot 2 the barley appeared rather better than on plots 3, 4, 5, and 6. On plot 12 (guano and dissolved coprolites) the barley appeared not much better than on the unmanured plot 6.

In Section B, plot 1 (ground coprolites), barley better than on plot 1 in Section A.

Plot 2 (dissolved coprolites), barley not so thick as on the corresponding plot in Section A.

No great apparent difference in the barley on plots 3, 4, 5, and 6.

On plot 7 (bone-meal), the barley was decidedly better than on the unmanured plot (6), except upon a patch where the barley, for some reason or other, was very light.

On plot 8 (dung, 20 tons per acre) the barley was visibly stronger than upon all other plots.

Plot 11 (chalk), barley rather better than on No. 12.

WOBURN ROOT EXPERIMENTS IN 1880; CROP SWEDISH TURNIPS (GIBBS'S selected PURPLE), each PLOT $\frac{1}{4}$ of an ACRE separated from the rest by PATHS $2\frac{1}{2}$ feet in width.

No. 12 A.	3 cwts. of dissolved coprolites, and $2\frac{1}{2}$ cwts. of Peruvian guano per acre; cost, 44*s.* 9*d.* per acre.	**No. 6 B.**	No manure.
No. 11 A.	Chalk 5 tons per acre; cost, 25*s.* per acre.	**No. 5 B.**	$4\frac{1}{2}$ cwts. precipitated phosphate per acre; cost, 22*s.* 6*d.* per acre.
No. 10 A.	Dung 10 tons and $6\frac{1}{2}$ cwts. of ground coprolites per acre.	**No. 4 B.**	$3\frac{1}{2}$ cwts. of dissolved bone-meal per acre; cost, 22*s.* 9*d.* per acre.
No. 9 A.	Dung 10 tons and 5 cwts. of dissolved coprolites per acre.	**No. 3 B.**	10 cwts. of Redonda phosphate per acre; cost, 21*s.* per acre.
No. 8 A.	Dung 20 tons per acre.	**No. 2 B.**	5 cwts. of dissolved coprolites per acre; cost, 22*s.* 6*d.* per acre.
No. 7 A.	3 cwts. of bone-meal per acre; cost, 22*s.* 6*d.* per acre.	**No. 1 B.**	$6\frac{1}{2}$ cwts. raw coprolites per acre; cost, 22*s.* 9*d.* per acre.
No. 6 A.	No manure.	**No. 12 B.**	3 cwts. of dissolved coprolites and $2\frac{1}{2}$ cwts. of Peruvian guano per acre; cost, 44*s.* 9*d.* per acre.
No. 5 A.	$4\frac{1}{2}$ cwts. precipitated phosphate per acre; cost, 22*s.* 6*d.* per acre.	**No. 11 B.**	Chalk 5 tons.
No. 4 A.	$3\frac{1}{2}$ cwts. dissolved bone-meal per acre; cost, 22*s.* 9*d.* per acre.	**No. 10 B.**	Dung 10 tons and $6\frac{1}{2}$ cwts. raw coprolites per acre.
No. 3 A.	10 cwts. Redonda phosphate per acre; cost, 21*s.* per acre.	**No. 9 B.**	Dung 10 tons and 5 cwts. of dissolved coprolites per acre.
No. 2 A.	5 cwts. dissolved coprolites per acre; cost, 22*s.* 6*d.* per acre.	**No. 8 B.**	Dung 20 tons per acre.
No. 1 A.	$6\frac{1}{2}$ cwts. ground coprolites per acre; cost, 22*s.* 9*d.* per acre.	**No. 7 B.**	3 cwts. bone-meal per acre: cost, 22*s.* 6*d.* per acre.

Harvest began on the 6th of September; the barley was cut on the 6th, 7th, and 8th of September, 1881; stacked on the 8th, 9th, and 10th of September; threshed out on the 17th and 18th of November; and the corn weighed and measured on the 22nd and 23rd of November, when the results embodied in the following Table were obtained:

PRODUCE of BARLEY in WARREN FIELD in 1881, after SWEDES in 1880.

Results calculated per Acre.

LOTS ¼ Acre each.	Manures used for Swedes.	Weight of Barley.				Number of Bushels.	Weight per Bushel.	Straw.			
		Tons.	cwts.	qrs.	lbs.		lbs.	Tons.	cwts.	qrs.	lbs.
1. A	Raw Coprolites ..	0	14	0	12	31	51	0	19	2	5
1. B		0	16	3	1	37	50¾	1	3	2	4
Mean		0	15	1	20½	34	51	1	1	2	4½
2. A	Dissolved Coprolites	1	0	1	1	43¾	51¾	1	7	3	18
2. B		0	17	0	4	36¾	52	1	6	0	7
Mean		0	18	2	16½	40¼	52	1	6	3	26½
3. A	Redonda Phosphate	0	18	2	2	39¾	52¼	1	6	2	2
3. B		0	19	0	1	40¼	52¾	1	7	2	3
Mean		0	18	3	1½	40	52½	1	7	0	2½
4. A	Dissolved Bone-meal	1	1	2	0	46¾	51½	1	9	3	3
4. B		0	19	0	14	41¼	51¾	1	7	2	5
Mean		1	0	1	7	44	51¾	1	8	2	18
5. A	Precipitated Phosphate	0	19	3	24	43	52	1	7	2	3
5. B		0	19	0	0	42¾	49¾	1	8	2	3
Mean		0	19	1	26	42¾	50¾	1	8	0	3
6. A	Unmanured ..	0	18	3	0	41¼	50¾	1	5	2	17
6. B		1	0	2	22	45¾	50¾	1	8	3	23
Mean		0	19	2	25	43½	50¾	1	7	1	6
7. A	Bone Meal	1	1	1	9	45	50½	1	10	1	25
7. B		0	14	3	4	32½	51	1	1	1	4
Mean		0	18	0	6½	38¾	50¾	1	5	3	14½
8. A	20 tons Dung ..	1	4	1	4	52¾	51½	1	14	3	2
8. B		1	3	0	14	49½	52¼	1	11	1	0
Mean		1	3	2	23	51	52	1	13	0	1
9. A	10 tons Dung and Dissolved Coprolites	0	17	1	9	39	50¼	1	5	3	16
9. B		1	1	1	21	43¾	52	1	7	2	10
Mean		0	19	1	15	41¼	51¼	1	6	2	27
10. A	10 tons Dung and Raw Coprolites	0	18	2	19	41½	50	1	7	1	11
10. B		1	1	1	3	44	51¼	1	3	2	25
Mean		0	19	3	25	42¾	50½	1	5	2	4
11. A	Chalk	0	19	1	7	43¼	49¾	1	9	0	4
11. B		0	19	3	22	42¼	50¼	1	5	0	16
Mean		0	19	2	14½	42¾	50	1	7	0	10
12. A	Peruvian Guano and Dissolved Coprolites ..	0	19	0	2	42½	50	1	5	0	6
12. B		0	19	0	25	42½	50½	1	3	0	3
Mean		0	19	0	13½	42½	50¼	1	4	0	4½

The plots No. 1 in Section A, and No. 7 in Section B, are at the end of the field, where the soil, from some cause or other, is clearly less productive than the remainder of the field.

In Section A, on plot 1 (previous swede crop, manured with raw coprolites) the yield of barley amounted only to 31 bushels, whilst the duplicate experiments in Section B produced 37 bushels.

It would evidently not be fair to compare the produce of plot 1 (ground coprolites) with that of the adjoining plot 2 (dissolved coprolites), which gave 37 bushels; nor would it be proper to compare the produce of plot 1 in Section B (ground coprolites) with that of plot 2 in Section B (dissolved coprolites), for on the latter, for some reason or other, less barley was reaped than on the unmanured plot.

On Section B, plot 7 (bone-meal), it will be seen, produced only $32\frac{1}{2}$ bushels of barley, or only $1\frac{1}{2}$ bushels more than was obtained on the opposite plot 1 (ground coprolites), which clearly shows that the land at the end of the field where these two quarter-acres are situated is not so good as in other places, for in the duplicate plot 7 in Section A (bone-meal plot) 45 bushels were grown.

In future experiments the plots 1A and 7B will, I fear, have to be thrown out altogether.

That the land on this part of the experimental six acres is really poorer than the rest of the field is also proved by the results of the previous swede crop.

In Section A, plot 1 (manured with ground coprolites) produced 19 tons 3 cwts. 1 qr. 8 lbs. of clean swedes per acre (topped and tailed), whereas,

In Section B, the ground coprolites produced 23 tons 1 cwt. 3 qrs. of topped and tailed clean swedes.

Again, on the opposite plot 7 in Section B, manured with bone-meal, only 18 tons 1 cwt. 2 qrs. 20 lbs. of topped and tailed roots were grown; and on the duplicate plot, Section A, 20 tons 2 cwts. 2 qrs. 16 lbs.

Eliminating the produce on plot 1, Section A, and of plot 7, Section B, and also of plot 2, Section B, from the remainder of the experiments, the results of the barley trials in 1881 show,—

1. That the plot upon which the preceding swede crop was manured with ground coprolites yielded at the rate of 37 bushels of barley per acre, weighing $50\frac{3}{4}$ lbs. per bushel.

2. That on the plot manured in the preceding year with dissolved coprolites $43\frac{3}{4}$ bushels of barley per acre were grown, weighing $51\frac{3}{4}$ lbs. per bushel, that is to say a better sample, weighing 1 lb. more per bushel than on the land previously manured with ground coprolites. Thus $6\frac{3}{4}$ bushels more barley

per acre were grown on the plot upon which mineral superphosphate (dissolved coprolites) had been applied in the preceding year to turnips.

3. That the heaviest crop was raised on the land which in the preceding year had been manured with 20 tons of dung. The average produce per acre of the two dung-plots, it will be seen, amounted to 51 bushels of barley, weighing 52 lbs. per bushel, and 1 ton 13 cwts. 1 lb. of straw.

4. That on the remaining plots the produce varied from 40 to 43 bushels of corn per acre, and from 1 ton 5 cwts. to 1 ton 8 cwts. of straw.

The clover sown with the barley came up well, and there is a good plant all over the field.

XIV.—*Annual Report of the Consulting Chemist for* 1881.

THE appended summary shows that during the twelve months beginning the 1st of December, 1880, to the 1st of December, 1881, 1058 samples were sent to the Laboratory by members of the Royal Agricultural Society.

Whilst fewer samples of superphosphates, bone-dust, compound artificial manures and feeding-cakes were received for examination, applications for analyses of soils, and reports on their chemical and physical properties and the best means of raising their productiveness, have been more numerous than in the preceding year. Complete soil-analyses, if carefully performed, involve much expenditure of time and delicate analytical work, which, in addition to ordinary work, has occupied myself and assistants fully as much as in the preceding year, when over 100 more of comparatively simple analyses of feeding-cakes were made than during the last twelve months. In most instances the soil-analyses were accompanied by lengthy reports on the manures most suitable to cereal or root-crops intended to be grown, the course of cropping suggested on particular soils, and generally the means of maintaining or increasing their fertility and productive powers. In the course of last year 60 such soil-reports were made for members of the Society, or 26 more than in the preceding year, which is a large and satisfactory increase over former years, and indicates a greater and more gratifying appreciation of reports, which some four or five years ago were but rarely demanded by English Agriculturists.

Inferior Artificial Manures sold under wrong names.—As usual, a number of inferior artificial manures and oilcakes passed

through my hands in the course of last year, which were worth much less than the price at which they were sold. I would also direct attention to the fact that artificial manures sometimes are sold under wrong names. Thus, steamed bones, or the refuse bones of glue and size makers, are occasionally sold as bone-dust at the full price at which raw bone-dust can be bought. The purchaser who pays the full price for ¼-inch raw bones or raw bone-dust, reasonably expects to be supplied with raw bones, and not with steamed or glue-makers' refuse bones which contain only about one-third the amount of nitrogen found in raw bones, and are worth fully 1*l.* less per ton than the latter. Again, purely mineral superphosphates sometimes are sold as bone-manures, at much higher prices than they would be likely to realise if they were sold under their right names.

It is true that, in a certain sense, a mineral superphosphate, being made from fossil bones, may be called a bone-manure; but in the usual sense understood this term implies that a manure contains either raw, or boiled, or dissolved bones, and it is clearly wrong to sell a purely mineral superphosphate as a bone-manure, especially if it is not a first-class superphosphate and is sold at an extravagantly high price. A case of this kind was brought under my notice by a gentleman who bought as bone-manure, at 6*l.* 10*s.* per ton, a mineral superphosphate, which, on analysis, had the following composition:—

Moisture	18·80
Water of combination	8·81
Monobasic phosphate of lime	12·59
(Equal to tribasic phosphate of lime rendered soluble by acid)	(19·71)
Insoluble phosphates (mineral)	9·40
Sulphate of lime, &c.	44·81
Insoluble siliceous matter	5·59
	100·00
Nitrogen	None.

This manure would have been dear at 4*l.* 10*s.* a ton, for at that price, or even less, good mineral superphosphate, containing 25 to 26 per cent. of soluble phosphate, can be readily bought.

Artificial Manures sold much below their fair market value.—It does not often happen that artificial manures are sold much below their real value, but I have had manures sent to me for analysis, which, according to their composition, could not possibly be sold legitimately, even without profit, at the prices at which I was informed they were actually sold.

Thus, not long ago, a member of the Royal Agricultural Society sent me two samples, one of which was described as

nitrophosphate and the other as bone-compound. The former was sold at *3l.* 15*s.* per ton, and the latter at *4l.* 5*s.* per ton. On analysis I obtained the following results:—

	Nitrophosphate, Cost £3 15s. per ton.	Bone-Compound, Cost £4 5s. per ton.
Moisture	16·20	12·15
*Organic matter and water of combination	29·72	18·14
Monobasic phosphate of lime—		
(Equal to tribasic phosphate of lime	13·27	17·62
Rendered soluble by acid)	(20·78)	(27·59)
Insoluble phosphates	4·41	9·65
Sulphate of lime, &c.	26·49	32·45
Insoluble siliceous matter	9·91	9·99
	100·00	100·00
*Containing nitrogen	1·42	1·07
Equal to ammonia	1·72	1·29

I am at loss to understand how it is possible to sell two such excellent manures, without a considerable loss, at the prices at which I was informed they were sold. It appears to me that either the manufacturers of these manures were never paid for the manures by the dealer who sold them at the remarkably low price in order to dispose of them without difficulty, or that, for some illegitimate purpose or other, small quantities of the manures were prepared of very superior quality, which it was not intended to supply to the general public. I mention these particulars because, occasionally, a fraudulent use is made of *bonâ-fide* manure-analyses. Buyers of manures often are satisfied by having presented to them the analysis and favourable report of a respectable chemist, and never trouble themselves to have tested on delivery the manure bought on the strength of such an analysis.

The only real safeguard against frauds in manure dealings is to obtain from the dealer, in the first place, a written guarantee that the manure ordered shall agree in quality with that represented by the analysis, upon the strength of which the order has been given; and then, as a matter of course, to draw fair samples of the bulk on delivery, and to have them analysed by a competent chemist, who will be readily able to say whether the manure is equal to the guaranteed quality, or how much per ton it is worth less than the price which the buyer agreed to give for a manure of a definite composition.

I fear that sometimes farmers are suspicious in matters where they should show confidence, and incautious in dealings in

which the display of good business habits would often prevent losses. This want of business habits probably explains the fact that chemical analyses, so well-calculated to guard purchasers of manures against losses or unfair dealings, are sometimes made the instruments of deception on the part of manure-dealers.

Advantage of buying Artificial Manures by Analysis.—The following are fresh illustrations of numerous other cases of the advantage of buying manures by analysis, which have been brought under my notice during the last twelve months.

A member of the Society sent me three samples of manure: one, a special quality of dissolved bones, guaranteed to contain 40 per cent. of phosphate and 2 per cent. of ammonia, price 8*l.* 7*s.* 6*d.* per ton, subject to discount for cash; the second sample was turnip manure, guaranteed to contain 20 to 21 per cent. soluble phosphate and 2½ to 3 per cent. of ammonia, price 8*l.* per ton, less discount for cash. No. 3 was a sample of Peruvian guano, guaranteed to contain 28 to 30 per cent. phosphates and 12 per cent. ammonia, price 14*l.* per ton, nett cash.

The following is the composition of these three manures:—

	Special Dissolved Bones.	Turnip Manure.
Moisture	9·20	12·40
*Organic matter and water of combination	28·76	20·58
Monobasic phosphate of lime	7·99	13·34
Equal to tribasic phosphate of lime (bone phosphate) rendered soluble by acid	(12·5)	(20·89)
Insoluble phosphates	19·01	7·24
Sulphate of lime .. .. Alkaline salts and magnesia	32·74	41·43
Insoluble siliceous matter	2 30	5·01
	100·00	100·00
*Containing nitrogen	2·24	1·52
Equal to ammonia	2·72	1·84

Peruvian Guano.

Moisture	6·30
*Organic matter and ammoniacal salts	27·05
Phosphate of lime	16·05
†Alkaline salts	13·06
Insoluble siliceous matter	37·54
	100·00
*Containing nitrogen	6·33
Equal to ammonia	7·69
†Containing phosphoric acid	2·42
Equal to tribasic phosphate of lime	5·28
Total percentage of phosphoric acid	9·77
Equal to tribasic phosphate of lime	21·33

The special dissolved bones thus showed a deficiency of $8\frac{1}{2}$ per cent. of phosphates, for which deficiency I recommended the buyer to deduct 17*s.* per ton.

The turnip manure showed a deficiency of ammonia, for which an allowance of 12*s.* per ton was claimed; and the Peruvian guano turned out both deficient in phosphates and in ammonia; the deficiency in phosphates amounted to 7 per cent., and that in ammonia to $4\frac{1}{3}$ per cent., or, in other words, the guano was worth 4*l.* 15*s.* 6*d.* less per ton than that represented in the analysis by which it was bought.

Peruvian Guano.—In the Annual Chemical Reports for 1879 and for 1880, I directed attention to the unsatisfactory manner in which commercial transactions in guano are carried on. Peruvian guano, as is well known, is sold by the Government contractors or agents, at prices varying with the composition and quality as ascertained by the analysis of fairly drawn samples of each cargo on arrival in this country. Reference has been made in former reports to the practice of unscrupulous manure dealers in selling Peruvian guano of inferior quality at the top price at which high quality guano is usually sold. Judging from the number of similar cases which have come under my notice within the last twelve months, this practice does not appear to have been abandoned, but rather to have increased; and, moreover, I am inclined to think that a fraudulent use is sometimes made of official analyses of cargoes of guano of good quality, and that inferior guanos are sold to farmers on the strength of analyses which refer to superior cargoes, and not to the inferior guanos from which the buyer has been supplied. It will not be amiss for me, therefore, to refer once more in this Report to the prevalence of the unsatisfactory condition of the trade in Peruvian guano.

The composition of 11 samples of Peruvian guano which have lately been analysed by me is shown in the Table on page 338.

The guano marked No. 1 was sold at 13*l.* 15*s.* a ton, which is a high price for a guano represented to contain 8·86 per cent. of ammonia and 33·81 per cent. of phosphates, but which, on analysis, was found to contain only 6·73 per cent., and was worth 30*s.* less per ton than the guano represented in the official analysis.

No. 2 was sold in Liverpool at 12*l.* 5*s.* a ton; but as it contained only $6\frac{1}{4}$ per cent. of ammonia, it was not worth more at Liverpool than about 9*l.* 10*s.* a ton.

No. 3 was sold at 13*l.* 10*s.* a ton, although it contained only $8\frac{1}{4}$ per cent. of ammonia. 11*l.* a ton is about its true value.

No. 4 sample, although really a better guano than No. 3, was

COMPOSITION of 11 SAMPLES of PERUVIAN GUANOS.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.	No. .	No. 10.	No. 11.
Moisture	16·60	20·05	13·40	10·51	15·55	9·45	10·40	11·75	14·65	14·60	6·51
*Organic matter and ammoniacal salts	28·85	26·05	29·70	32·49	30·20	33·15	35·35	29·20	26·55	26·45	29·79
Phosphate of lime	24·15	20·61	15·45	25·96	16·11	17·45	16·79	18·47	12·87	15·28	19·63
†Alkaline salts	20·45	24·04	21·95	23·50	20·94	14·91	20·36	23·13	19·73	20·37	16·73
Insoluble siliceous matter	9·95	9·25	19·50	7·54	17·20	25·04	17·10	17·45	26·20	23·30	27·34
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
*Containing nitrogen	5·54	5·18	6·80	7·10	6·33	7·87	7·63	6·75	5·42	5·60	6·72
Equal to ammonia	6·73	6·29	8·26	8·62	7·69	9·56	9·26	8·19	6·58	6·80	8·16
†Containing phosphoric acid	5·46	4·39	3·17	none	3·02	4·37	3·48	3·63	3·34	3·18	2·60
Equal to tribasic phosphate of lime	11·91	9·58	6·92	..	6·59	9·54	7·59	7·92	7·54	6·94	5·68
Total percentage of phosphoric acid	16·52	13·83	10·25	11·89	10·40	12·36	11·17	12·11	9·35	10·18	11·59
Equal to tribasic phosphate of lime	36·06	30·19	22·37	25·96	22·70	26·99	24·38	26·39	20·41	22·22	25·30

sold at 12*l.* 15*s.*, or 15*s.* less than No. 3; why the better guano should have been sold at 15*s.* less per ton it is difficult to understand; No. 4, however, was too dear at 12*l.* 15*s.* a ton.

No. 5, sold at 12*l.* a ton (cash), was not worth more than about 10*l.* a ton.

No. 6, represented as a first-class guano, was sold at 13*l.* 10*s.* per ton; but in my judgment it was not worth more than about 12*l.* per ton.

No. 7 is a good guano, but too dear at 13*l.* 1*s.* 8*d.* by about 1*l.* a ton.

No. 8 was sold at Liverpool at 12*l.* 12*s.* 6*d.*, or about 1*l.* 12*s.* 6*d.* more than it was worth.

No. 9, a guano which contained only 6½ per cent. of ammonia, was sold as the *best* guano at 12*l.* a ton, or about 3*l.* more than it was worth.

No. 10 was also sold at 12*l.* per ton, and was scarcely worth 9*l.* 10*s.* a ton.

No. 11: the cost in Liverpool was 13*l.* 5*s.* a ton, but I need hardly say that such a guano was worth only from 10*l.* 10*s.* to 11*l.* a ton.

The following analyses show the composition of two samples of guano, represented as having been taken from the same ship. The guano was guaranteed to contain 10½ per cent. of ammonia and 24 per cent. of phosphates:—

PERUVIAN GUANOS.

	No. 1.	No. 2.
Moisture	13·28	7·45
*Organic matter and ammoniacal salts	33·59	28·01
Phosphate of lime	20·29	17·60
†Alkaline salts	16·15	16·34
Insoluble siliceous matter	16·69	30·60
	100·00	100·00
*Containing nitrogen	7·49	6·16
Equal to ammonia	9·09	7·48
†Containing phosphoric acid	4·91	3·24
Equal to tribasic phosphate of lime	10·71	7·07
Total percentage of phosphoric acid	14·20	11·30
Equal to tribasic phosphate of lime	31·00	24·67

The sample marked No. 2, it will be seen, differs greatly in composition from No. 1. No. 2 contained 30·6 of sand, and 2½ per cent. less ammonia than No. 1.

Two other samples, represented to have been taken from the same ship, on analysis had the following composition:—

	No. 1.	No. 2.
Moisture	9·45	10·60
*Organic matter and ammoniacal salts	33·15	43·64
Phosphate of lime	17·45	20·44
†Alkaline salts	14·91	16·72
Insoluble siliceous matter	25·04	8·60
	100·00	100·00
*Containing nitrogen	7·87	10·32
Equal to ammonia	9·56	12·53
†Containing phosphoric acid	4·37	4·44
Equal to tribasic phosphate of lime	9·54	9·68
Total percentage of phosphoric acid	12·36	13·80
Equal to tribasic phosphate of lime	26·99	30·12

In reporting upon No. 2, I wrote to the gentleman who sent me both samples:

"DEAR SIR,—This is a very different guano from that you sent me last April. This guano is well worth 13*l.* 10*s.* a ton. If both samples were taken from same bulk, all I can say is, that the bulk is very unequal in character."

Before leaving the subject of Peruvian guano, I quote two more analyses of samples recently sent to me. Their composition was as follows:—

	No. 1.	No. 2.
Moisture	8·70	10·70
*Organic matter and ammoniacal salts	17·20	24·35
Phosphate of lime	16·36	22·38
†Alkaline salts	37·89	30·97
Insoluble siliceous matter	19·85	11·60
	100·00	100·00
*Containing nitrogen	3·60	5·21
Equal to ammonia	4·37	6·33
†Containing phosphoric acid	3·21	4·11
Equal to tribasic phosphate of lime	7·01	8·97
Total phosphoric acid	10·70	14·37
Equal to tribasic phosphate of lime	23·36	31·35

No. 1 is poor in ammonia, but it was sold at only 8*l.* 7*s.* 6*d.*, a fair price for such a guano.

No. 2 was sold at 8*l.* 17*s.* 6*d.* per ton at Liverpool.

In the preceding table (p. 338) showing the composition of 11 samples of Peruvian guano, the sample marked No. 2 has pretty much the same composition. If anything, the sample which only cost 8*l.* 17*s.* 6*d.* per ton in Liverpool was rather better than those which were sold at the same port at 12*l.* 5*s.* a ton.

Considering the uncertainty of obtaining raw Peruvian guano of a uniform quality at a reasonable price, and also the additional trouble of having to break the hard lumps which occur in some kinds of guano, and to remove the stones by sifting, I am glad to find that raw Peruvian guano can now be bought in a finely sifted dry powdery condition on the basis of a guaranteed percentage of ammonia.

Olive Refuse.—A sample of olive refuse from the presses, after extracting olive-oil, had the following composition :—

Moisture	12·20
Oil	11·95
*Albuminous compounds (flesh-forming matters) ..	4·75
Mucilage, sugar and digestible fibre	25·24
Indigestible woody fibre	41·76
Mineral matter (ash)	4·10
	100·00
* Containing nitrogen	·76

Olive refuse, it will be seen, contains a large proportion of indigestible woody fibre, due to the olive-stones, which, apart from the oil, constitute the larger portion of olives. It is poor in albuminous matter, but contains a good deal of oil. Pigs eat olive press-cake readily, and they are largely fed upon it in Spain. In England olive refuse is mainly used for adulterating oilcakes, or in the manufacture of cheap feeding-cakes and meals.

Biscuit Scraps.—A sample of biscuit scrap was found to have the following composition :—

Moisture	3·01
Oil	2·01
*Albuminous compounds	10·81
Starch and sugar	81·19
Woody fibre (cellulose)	·93
Mineral matter (ash)	2·05
	100·00
* Containing nitrogen	1·73

This is a good and useful and cheap feeding-material, if it can be bought for about 7*l.* 10*s.* a ton.

Good's Forage-Cake.—Good's forage-cakes, or rather loaves,

are a kind of coarse bread. A sample sent to me for analysis a short time ago had the following composition:—

Water	42·33
*Albuminous compounds (flesh-forming matters) ..	9·44
Starch, dextrin and sugar	43·59
Woody fibre	2·01
Mineral matter (ash)	2·63
	100·00
* Containing nitrogen	1·51

Drinking Waters contaminated with Lead.—Of the 87 samples of waters intended for drinking and general domestic purposes, not a few were found largely contaminated with sewage, or similar injurious drainage products, and quite unfit for drinking purposes. In four samples I found lead in sufficiently large proportion to cause serious indisposition and to explain the characteristic effects which drinking waters contaminated with lead produce on the constitution of men and animals. These four waters had the following composition:—

	No 1.	No 2.	No. 3.	No 4.
Total solid matter	3·92	4·48	26·04	24·92
Containing—				
Oxidisable organic matter	·672	·112	1·12	·896
Chloride of sodium	1·65	1·65	6·92	6·92
Nitric acid	none	·35	7·01	8·40
Actual (saline) ammonia	·004	·001	·024	·026
Organic (albumenoid) ammonia	·003	·003	·003	·004
Oxide of lead	strong indications.			
Hardness	2°	3°	11°	12°

The water No. 1 was supplied from a large public reservoir, and from the main pipes was conveyed a distance of about 200 yards in a lead pipe to the house, the inmates of which experienced symptoms of lead-poisoning from drinking the water.

Both No. 1 and No. 2, as will be seen, were very soft waters, No. 1 containing not quite 4 grains of solid constituents in the imperial gallon, and No. 2 scarcely 4½ grains. Unusually soft waters are known to act upon lead pipes, and the general impression is that hard waters do not attack lead, and may be safely conveyed through leaden pipes without becoming contaminated with lead.

The analyses of the samples marked No. 3 and No. 4, however, show that this impression is not always correct, for we have here two examples of waters which are moderately hard, and, so far as I could judge, quite as largely contaminated with

lead as the soft water No. 1, which produced decided symptoms of lead-poisoning. Probably the presence of the considerable proportions of nitrates and chlorides in these waters explain their action upon lead pipes.

Interesting Poisoning Cases.—A member of the Society wrote to me as follows:

"DEAR SIR.—Having lost some beasts, and several others being ill, which have recovered after having been treated with sulphuric acid, I have reason to believe that the illness has been caused by the floor of the mixing-house getting mixed with the animals' food. I have sent you, therefore, a small sample, and shall be glad if you will give me your opinion on the following points:—

1. Whether it is of an injurious nature.
2. What the injurious element is—lead, sulphate of lime, or anything else.
3. What quantity of the stuff would cause death."

The material sent for examination had the appearance of cement or mortar, and on analysis was found to have the following composition:—

Water, and loss on heating	11·70
White lead	14·62
Sulphate and carbonate of lime, &c.	53·38
Insoluble siliceous matter	20·30
	100·00

The large proportion of white-lead, which, somehow or other had become mixed up with the food of the animals, fully explains the cause of the death of some of the animals and the serious illness of others. It is scarcely probable that white-lead had been used in the construction of the floor of the mixing-house, and in all likelihood the mischief was caused by rubbish, containing white-lead, gypsum, and mortar, having been left on the floor.

Another gentleman sent me for examination a bottle of a mixture which he obtained from a farrier, as a remedy against a bad cough, and subsequently the following note:

"On the 17th I had a cob with a bad cough. I asked ——— to give me a draught for him; he gave me the bottle I sent you, and the directions are on the bottle: a half to be given in the morning, which my man gave; the horse at once was seized with dreadful pain, and I sent for him, stating he had poisoned the horse. He came up and said he was very sorry, but had taken down the wrong bottle. The horse had neither eaten nor drunk since; his throat seemed quite closed. The farrier says that he put liquor ammoniæ into the mixture by mistake, but I think it must be something worse."

The examination of the contents of the bottle showed that in addition to a decoction, or infusion, of some vegetable substance, the liquid contained a large proportion of strong liquor ammoniæ and also much oil of turpentine. On allowing the bottle con-

taining the mixture to stand at rest for a short time, the oil of turpentine separated, and formed on the surface of the liquid an oily layer of about half an inch in depth.

Oil of turpentine, in conjunction with ammonia, is employed externally in the treatment of inflammation of the bowels or lungs. It is a rubefacient, like ammonia, and, as far as I know, is not given internally to horses to cure coughs.

When oil of turpentine is administered internally, for instance as a vermifuge, it is always given dissolved in linseed, or some other bland or aperient oil, or in the state of emulsion.

When liquor ammoniæ is given internally in certain disorders, half an ounce to one ounce is a proper dose, diluted with 20 to 30 ounces of water or cold gruel, or other mucilaginous diluents.

In the mixture examined by me, the liquor ammoniæ was only diluted with four parts of other liquids, and such strong ammonia, quite apart from the oil of turpentine, must have acted as a strong rubefacient or vesicant. There can therefore be no doubt that the mixture, merely diluted with a little gruel, when poured down the horse's throat must have caused intense pain to the poor animal, and have blistered the throat and partially removed the mucous membranes.

Composition of Fat Ball reported to have been found in the Stomach of a Cow.—Last June I received from a member of the Society a peculiar fatty substance, in which I found in 100 parts:—

Fatty acids (soluble in alcohol)	46·60
Neutral fats (insoluble in alcohol)	37·65
Membranous matter	8·15
Phosphate of lime	·90
Carbonate of lime, magnesia, &c.	1·20
Alkaline salts	1·40
Sand	4·10
	100·00

This curious substance, I was informed, was found in the stomach of a calf that died; it was a solid ball about 5 inches in diameter. My informant adds: "We have lost a cow, a horse, two young beasts, and three sheep; all died in the same way within a few weeks."

The 'Journal' of the Society for 1881 contains the following contributions of mine:

1. Chemical Report for 1880.
2. Quarterly Report to Chemical Committee.
3. Report on the Field and Feeding Experiments conducted at Woburn during the year 1880.
4. Field Experiments on Swedish Turnips with Soluble and finely ground Phosphatic Fertilizers.
5. Further Experiments on the Comparative Value of Linseed-cake and a mixture of Decorticated Cotton-cake and Maize-meal for fattening Bullocks.

Both the corn and root-crops in the Rotation experiments at Woburn yielded very satisfactory results in 1881. The rotation wheat produced about 7 quarters of good wheat, the rotation barley about 6 quarters, and the rotation mangolds from 20 to 24 tons of clean roots, without the tops.

The barley on the 24 plots of quarter of an acre each, which succeeded the experimental swedes grown with soluble and insoluble phosphates, also yielded satisfactorily, and the clover sown with the barley has come up well, and is now a strong plant throughout the whole 6-acre field, divided into 24 plots.

With the view of testing the effects of soluble and insoluble phosphatic manures, on lighter soil than that of Warren Field in which the experiments were tried in 1879, four additional acres of light land were set aside for such experiments, so that besides the original 21 acres under experiment, 12 acres more land have been taken in hand for experimental purposes within the last two years.

Some trials with maize, intended to be grown as a green forage plant, turned out complete failures.

The maize was attacked by insects, and the few plants which escaped the ravages of insects did not properly ripen; the maize, probably, was sown too late in the season.

In the course of the year I paid fourteen visits to the experimental fields at Crawley-Mill Farm.

Analyses made for Members of the Royal Agricultural Society from December 1880 *to* 1st *December*, 1881.

Guano	86
Fish guano	6
Superphosphates and dissolved bones, and compound manures	276
Bones, bone-dust and boiled bones	61
Nitrate of soda	25
Sulphate of ammonia	4
Potash salts .. .. –	6
Soot	4
Refuse manures	25
Wool-dust and shoddy	22
Sewage and sewage-manures	5
Manure rape-dust	4
Limestone, chalk and minerals	21
Soils	60
Corn, hay, malt-dust and other vegetable products ..	12
Milk	1
Feeding-cakes	319
Feeding-meals	24
Cattle spices	2
Waters	87
Examinations for poison	8
Total	1058

XV.—*On Purples or Ear-cockle in Wheat.*

By WILLIAM CARRUTHERS, F.RS., Consulting Botanist.

PURPLES, ear-cockle, or pepper-corn, is a disease in wheat caused by the attack of a minute worm. It is happily not a frequent disease. When it occurs it is local, and sometimes very injurious. The ear of wheat is full-grown, the seeds, in one or more cases, are replaced by small roundish bodies, shorter than the seed, and somewhat broader, and nearly black in colour. When one of these bodies is cut through, it is found to consist of a considerable thickness of dark empty cellular tissue surrounding a kernel of a white cotton-like substance. If this kernel be placed in water it breaks up into short, separate, moving threads, which are revealed by the microscope to be a mass of minute worms.

The presence of these worms in the ear-cockle has been long known. They were first detected by Needham, in 1748. And they have formed the subject of special papers by Roffredi, Bauer, Henslow, and Davaine. More recently the group to which these worms belong has been studied by other naturalists, and large additions have been made to our knowledge of them by Bastian, De Max, Oerley, and others. The species that attacks the wheat was called *Vibrio triticum* by Bauer, afterwards *Anguillula graminearum* by Diesing, and is now known as *Tylenchus Tritici* of Bastian. It belongs to the order *Nematoidea*, a group of round thread-worms which are found either parasitic on other animals, or living free in salt or fresh water, in moist earth, and on or in plants. Bastian, as the results of his investigations, expresses his belief that the free nematoids will be found to constitute one of the most widely diffused and universally abundant groups in the whole animal kingdom. In the short space of fifteen months he obtained from a few limited districts, no less than one hundred species that had not been previously described.

The members of the parasitic group of these minute nematoid worms inhabit the bodies of animals of all kinds, man himself being the chosen habitat of no less than twelve species. The best-known of these are the Guinea-worm, common in the intertropical regions of the Old World, and *Trichina spiralis*, which produces the disease called Trichinosis. This worm is known in two different conditions. In its first or immature condition it is found in the muscles of the pig. When a portion of the muscle containing the parasite is eaten by another warm-blooded animal, the worm multiplies rapidly, and pushing its way through the intestinal canal, takes possession of the muscles,

and reproduces itself with marvellous rapidity. The disease known as the "gapes" in poultry is caused by a nematoid worm, which is developed in great abundance in the alimentary canal; from the canal the worms find their way into the lungs, causing the choking which too often proves fatal to the bird.

But it is to a free nematoid worm that the disease in the wheat is due. This division of the order is found in great abundance wherever these animals have been studied. Bastian obtained a large number of species in a few months in a limited locality. Dr. De Max has described one hundred and forty-one species from Australia. Dr. Joseph has lately been investigating the species in the dark caves of Carniola, and he has there found no less than fifteen species belonging to several genera.

These small nematoid worms are frequently met with in decaying fruit and vegetables, and they are found in connection with living plants, though in many cases they do not appear to produce any injury. At Broadmoor, in Berkshire, Mr. Bastian found ten species on wheat; six of them were found attached to the roots of the wheat,* and three were discovered between the sheath of the leaves and the stalk or culm of the wheat,† while one species was observed associated with the plant both below and above ground, being detected between the stem and leaves and on the rootlets as well.‡ Three species were found in connection with oats, two being found on the roots,§ and one between the leaf-sheaths and the stalk.|| Three species were also found by Bastian in connection with the giant fescue (*Festuca elatior*); all of them were detected between the stem and the leaf-sheaths.¶

Rev. M. J. Berkeley described some cucumber-plants from a garden at Nuneham, which were injured by a small nematoid worm. The leaves were covered with brown spots, and some were found also on the stem. On lifting the plants the roots were noticed to be covered with small excrescences, from the size of a pin's head to that of a nutmeg. These excrescences were of a dirty cream colour, somewhat spherical, and were found to be developed on one side of the root. In section they consisted of irregular radiating whitish masses of vascular tissue,

* *Diplogaster albus*, Bastian, 'Linn. Soc. Trans.' xxv. p. 117; *D. filiformis*, Bastian, l.c.; *Cephalobus striatus*, Bastian, l.c. p. 125; *Tylenchus terricola*, Bastian, l.c. p. 127; *Rhabditis longicaudata*, Bastian, l.c. p. 130; and *R. aeris* Bastian, l.c.

† *Plectus Tritici*, Bastian, l.c. p. 120; *Cephalobus persegnis*, Bastian, l.c. p. 124; and *Rhabditis ornata*, Bastian, l.c. p. 130.

‡ *Dorylaimus Tritici*, Bastian, l.c. p. 107.

§ *Plectus granulosus*, Bastian, l.c. p. 120; *Tylenchus obtusus*, Bastian, l.c. p. 128.

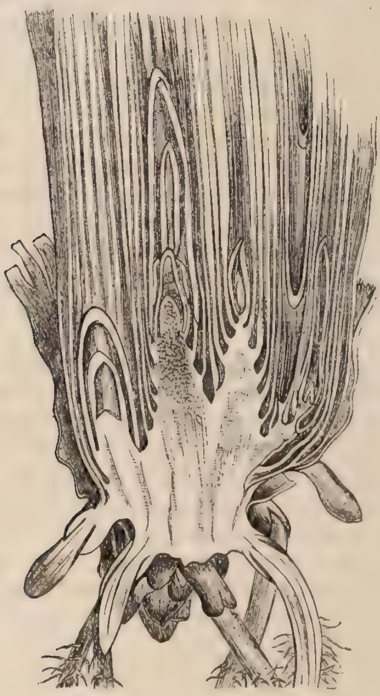
|| *Aphelenchus avenæ*, Bastian, l.c. p. 123.

¶ *Mononchus papillatus*, Bastian, l.c. p. 101; *Dorylaimus papillatus*, Bastian; and *D. torpidus*, Bastian, l.c. p. 108.

with numerous large open ducts intercepted by loose cellular tissue, resembling medullary rays, and passing gradually into a thick external covering of parenchymatous cells. Throughout the substance of the excrescence were numerous cyst-like bodies, filled with a multitude of minute elliptic eggs, containing a coiled-up worm, and some worms had escaped from the eggs and were free in the cysts. Mr. Berkeley believed that the injury was caused by the nematoid worms.

A similar malady has, during the past year, been observed in carnations. The plants were observed to be sickly, and the leaves were found to be covered with light-coloured spots. When dissected and examined under the microscope it was found that the spots were due to the presence in the cellular substance of

Fig. 1.—*Section of a young Plant of Wheat, six weeks old, with the principal Axis attacked by a Vibrio.*



the leaf of numerous minute worms and their oval eggs. Having gained access to the interior of the leaf, they pushed their way under the skin, destroying and consuming the soft cellular tissue. This so injured and weakened the plants that they were unable to flower.

Bauer observed at Kew, not unfrequently, an injury done to the young stem of wheat by one of these worms, which has not since been particularly noticed. The illustration given (Fig. 1) is from Bauer's drawing. The dark shading on the stronger of the two central stems indicates the injury done by the worm; and this is so serious that the vitality of this stem is destroyed. The worm producing this disease is smaller than that found in the ear gall, is a different species, and probably belongs to a different genus.

When we examine a spikelet of wheat affected with purples, we find that there are present the empty scales or glumes at the base of the spikelet, and the two glumes at the base of each

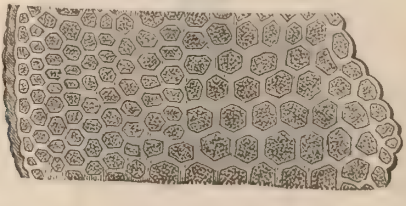
Fig. 2.—*Spikelet of Wheat containing four Pepper-corn Grains (magnified).*

flower. The gall is within these flower-glumes. At its first appearance it may be distinguished by its being of a darker green than the healthy grain. It darkens in colour until ultimately it becomes nearly black, and being of a round form it has the aspect of a small pepper-corn. But the gall is not a simple body. It consists of two parts, more or less completely separated. The gall is generally considered to be the grain so altered that, instead of the embryo and the store of starch, we find a mass of minute worms. The pistil of the wheat, however, is a single central one-celled body, whereas the gall consists of two opposed parts. Nothing whatever is found within the glumes which contain the galls. On examining the gall itself we discover that each half is surrounded by a ridge terminating in a toothed apex, and that it is sparsely covered on its upper and outer portions with short bristle-like hairs. This double

nature of the gall proves that the organs altered by the worm could not be the single central pistil, but a pair of opposed appendages. The only parts of the flower which could be converted into such galls are the two membranous scales forming the perianth of the flower. Accepting this interpretation of their nature, we find that the ridge in the gall would represent the margin of the leaf, while the fine hairs which cover the apex of the scale on its outer surface are converted into the short bristly hairs on the gall. I have never been able to detect any trace of stamens or pistils within the glumes, or scales containing the galls. Davaine has observed, but only very rarely, organs which he recognised as a stamen or a pistil along with the gall. From his figures of these abnormal galls it is evident that the vibrio had attacked only one of the flower-scales, and that there still remained sufficient vigour in the axis to produce the imperfectly formed stamen or pistil. In the first stages of development the flowers of wheat are mere swellings on the simple axis or stalk. Each swelling lengthens, and becomes a lateral axis or stem; and on this secondary stem swellings appear, which gradually enlarge, and shape themselves into the different parts of which the flower is composed.

The vibrio must attack the flower at that stage in its development when the only swellings on the flower-axis are the lower and outer ones, which develop into the membranous scales of the perfect flower.

Fig. 3.—*Section of the Wall of the Gall, showing the great number of thick-walled Cells.*



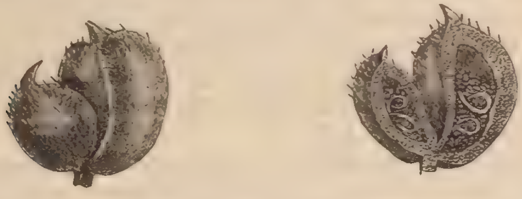
When the vibrio penetrates the minute swellings a vigorous flow of sap is directed to the locality, as in the case of other galls, probably with the view of healing the injury. An abnormal development at once proceeds, which arrests the formation of the swellings which would become the stamens and pistil. The cells forming the two surfaces of the scale increase in number, and their walls become thick (Fig. 3), and form a dense protective covering to the enclosed worms.

This interpretation of the nature of the organs altered in the gall, derived from the examination of a large series of galls,

receives confirmation from the observations and experiments of Davaine. He made many attempts to produce the disease in healthy plants, but he found he could not succeed unless he applied the vibrios at a very early stage of the development of the flower, when it was yet only a few millimetres long, and before the scales or paleoles, stamens and pistil, are distinct from each other. As soon as the plant had reached that stage in development, in which the stamens appear and the pistil can be distinguished, it was proof against the attack.

The growth of the gall is, as I have said, much more rapid than the growth of the natural flower. In the earlier stages of the gall the nature of the organs which the worm has attacked can be more clearly determined. The margin of the leaf can be traced terminating in the somewhat indurated apex, and the hairs more closely correspond with the hairs on the properly-formed scales.

Fig. 4.—*Young Galls, external aspect and section, showing in each Cell one or two Parent-worms and a great mass of Eggs.*

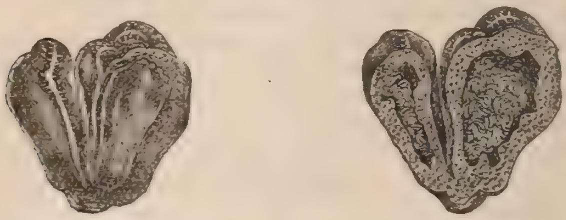


When the galls in this early stage are cut and examined (Fig. 4), they are found to contain one or more parent worms with numerous eggs. The eggs may be observed in all stages of advancement (Fig. 5).

Fig. 5.—*Adult Female Vibrio* (Tylenchus tritici, Bastian), *with Eggs, from some of which the young Worms are escaping.*

Soon after the mother-worm has completed the laying of the eggs she dies. By the time that the crop is ripe and the galls have attained their maturity the whole of the eggs have been hatched, and a section of the full-sized gall contains within the thickened walls only a cotton-like mass of minute worms (Fig. 6).

Fig. 6.—*Full-sized Galls, external aspect and section, showing the dense cottony mass of Worms filling the interior.*



As long as the galls are kept dry the worms remain in a torpid condition. They are able to retain their vitality for a long time, but when the gall obtains a supply of water the worms become active; they penetrate the wall of the gall and escape. Even after they have left the gall they may be dried up and become torpid, and remain in this condition for a considerable time without being killed, for when moisture is applied to them they revive again.

The careful consideration of these facts in the history of this disease of the wheat will convince the reader that great precaution should be exercised in preventing any of the galls being sown with the seed. For each gall sown may supply tens of thousands of worms, ready to prey on the young wheat plants. The attack is made when the crop is only a few weeks' old. It might be expected that in the case of winter wheat the frosts would kill these thin-skinned delicate worms. No doubt many thus perish; but intense cold, like complete desiccation, does not succeed in killing them. They may be enclosed in solid ice, and yet after the ice is melted they begin to move about in the water. The power of such worms in resisting the severest cold is strikingly manifested in the case of a grass brought from the Arctic regions in 1850 by Captain Puller. This grass had been attacked by vibrios, and several galls were found among the grains. These galls were brown, hard, and flask-shaped, with a white-tipped neck like that of a Florence flask. The walls of the cells were hard and thick, and the interior was completely filled with a white cotton-like pellet consisting of an infinity of little worms, with a few eggs scattered among them. The worms were smaller than those found

in the gall of the wheat. These worms must have remained alive through the long and severe winter of the Arctic regions, and still have been able on the return of summer to attack the young grasses.

It is, then, obvious, that the greatest care should be taken to prevent the galls being mixed with seed corn.

Indeed, the galls should be separated from wheat, no matter for what purpose it is to be used. They are, to say the least, utterly valueless as food. They may, on the other hand, be the cause of disease in animals which swallow them with their food. In every case the galls should be separated from the good grain, and completely destroyed by burning.

The illustrations of this paper are from original drawings by Francis Bauer, now preserved in the Department of Botany, British Museum—Natural History.

XVI.—*The late Edward Bowly, of Siddington.* By Professor WRIGHTSON, President of the College of Agriculture, Downton, near Salisbury.

ALL breeders of Shorthorns, all old Cirencester students, all sportsmen who have hunted through Braydon Forest and the Vale of White Horse country, and all frequenters of our great Agricultural Shows, will have heard with regret of Mr. Edward Bowly's death. Widely as he was known both in the United Kingdom and in America, he was especially beloved in and around his home, and in his own neighbourhood and county. His genial and unaffected manners, straightforward, if somewhat old-fashioned opinions, and his genuine respect for his "brother farmers," won their esteem and love, so that no man was more respected and liked than he on the Cirencester market. It is pleasing to think of him in his domestic and social character, but as a leading member of this Society and an eminent agriculturist, we must glance at his public rather than at his private influence. Looking then at Mr. Bowly as a public man, we see in him an improver of cattle and sheep, a promoter of agricultural improvements, and of technical education as bearing upon agriculture. Mr. Bowly was not an orator, but he was a pithy and animated speaker, throwing into his remarks much force of voice and manner. His leading topics were connected with farming, but when occasion offered, he was ever willing to slide on to the as congenial subject of fox-hunting, and this was often the prelude to a spirited harangue on the "good old Constitution" of old England. Let the many

who will read this brief memorial of a dear old friend call to mind his cordial and always well-received rallying cry of "one more cheer for the good old Constitution." He was a man of undoubted "pluck," as was abundantly proved by his riding. I am informed that he only took to hunting in middle life; and yet no man rode straighter across country, and no one more thoroughly felt the keen natural love of sport. He was also bold as a farmer and man of business. It was the late Earl Ducie who persuaded him to take up Shorthorn breeding some fifty years ago, and he commenced with a few animals purchased from Miss Strickland. Later he saw clearly the necessity of breeding from sires of pure and fashionable blood, and this sound policy he consistently carried out. His "Musicals," "Gazelles," and "Rubies" were successively allied to "4th Duke of Oxford," 11,387, "7th Duke of York," 17,754, "3rd Duke of Clarence," 23,727, and "2nd Duke of Tregunter," 26,022, and the result was a remarkably fine and uniform herd, boasting several consecutive "Duchess" crosses. There was also added a famous cow, Kirklevington 7th, whose progeny were subsequently named "Siddingtons." Mr. Bowly was associated in Shorthorn breeding with Colonel Kingscote, and with Mr. Stiles Rich of Didmarton. His most successful sale took place April 22nd, 1875, when thirty head of cattle realised an average of 207*l.* 18*s.* 8*d.*, and one animal was sold for 650 guineas.

Although our lamented friend will probably be best remembered as a breeder and judge of Shorthorns, his energies were displayed in other directions. From 1864 up to the time of his death he was a most useful member of the Council of this Society. In conjunction with the late Mr. Edward Holland he was largely instrumental in inducing the Society to institute examinations in agriculture, and to grant a diploma of proficiency and other prizes. He was one of the earliest promoters and most constant supporters of the Royal Agricultural College, Cirencester, and was one of its Governors. As a writer Mr. Bowly was not widely known, although what he did add to agricultural literature was eminently practical and useful. He contributed two prize essays to this 'Journal': the first "On the Advantages of One horse Carts over Waggons," in 1845, and the other "On the Management of Breeding Cattle," in 1858. He also wrote a Report on the Live Stock exhibited at Leicester in 1868 in his capacity of Senior Steward. Besides his work in connection with agriculture, Mr. Bowly was a Director of the County of Gloucester Bank, and the head of the firm of Bowly and Son, of the Cotteswold Brewery.

Mr. Bowly was a Tory in politics, and a Churchman in religion. His family have been established for many generations

around Cirencester, and it is satisfactory to know that Siddington House will still be retained by them, it having become the property of Mr. Christopher Bowly, nephew of our deceased friend. In Mr. Bowly the Royal Agricultural Society has lost a sound adviser and active coadjutor. It is well to cherish some memory of his appearance and manners. He was tall and very thin, as are most of his family, erect and distinguished in appearance, very courteous, friendly and jocose in his manner, and hearty in his laughter. He was a staunch upholder of the country party, and often avowed a good-tempered dislike for Birmingham and Bright. In his opinion, "the farmers were the backbone of the country." Mr. Bowly had long been in failing health, but his death took place rather unexpectedly on March 19th last. He was born July 26, 1808, and was therefore in the seventy-fourth year of his age. He leaves a widow, and two sons and two daughters.

XVII.—*The late Thomas Aveling.* By H. M. Jenkins, F.G.S., Secretary of the Society, and Editor of the 'Journal.'

The death of a Member of the Council of this Society always leaves a considerable gap in that body, owing to its representative nature; but as some men have greater ability and greater capacity for work than others, they naturally fill a greater space in the estimation of their colleagues and of the public. Mr. Aveling, whose almost sudden death has already been mourned by all classes of agriculturists, by agricultural and mechanical engineers, by his workpeople and his townsmen—I scarcely dare mention his family—was one of those able and energetic men who are bound to make a considerable figure in any sphere of usefulness. It is my mournful duty to give a short record in this 'Journal' of the services which Mr. Aveling has rendered to agriculture; but as he was one of my intimate friends I should not consider that I had done justice to his memory if I did not also attempt to compress into the space allotted to me some illustrations of the nature of the man. I am indebted to his cousin, Mr. Stephen T. Aveling, for most of the facts relating to the earlier periods of his life.

Thomas Aveling was born at Elm, in Cambridgeshire, on September 11th, 1824; he was the eldest of three children—all boys—and in fact he was the eldest son of the eldest son in an old Cambridgeshire family for at least nine generations. His father died while he was still young, and his mother went to live at Rochester, where she subsequently married again. Her second

husband was a clergyman, the Rev. J. d'Urban, of Hoo-Saint-Werburgh. This gentleman brought up my deceased friend "with a Bible in one hand and a birch-rod in the other," which he once described to me as an undesirable method of training children. Whether it was owing to this training or other causes, I cannot say, but it appears certain that until he had nearly arrived at man's estate he was a dull and heavy, but withal a thoughtful boy.

Mr. Aveling's first occupation was farming, under the late Mr. Edward Lake, of Hoo, whose niece, the daughter of Mr. Robert Lake, of Milton-Chapel, near Canterbury, he subsequently married. Soon after his marriage he took a farm at Ruckinge, in Romney Marsh; but there can be little doubt that during his career as a farmer he was more exercised in his mind about the improvement of farming machinery than the growing of crops or the feeding of cattle; in fact, he was a born engineer.

Mr. Alfred Crosskill has written to me as follows: "He possessed in an eminent degree the intuitive perception of a natural mechanic, and it was a treat when going round the Showyard along with him to encounter a new machine or steam-ploughing engine. He would point out in terse and caustic language the ingenuity displayed by the maker in arranging many of the wearing parts so that they might get out of order as quickly as possible, or in putting others where they were most liable to breakage; on the other hand, he never failed to recognise anything that was new, useful, or likely to be of permanent value.

Another of his prominent characteristics was readiness in reply. A country gentleman of the old school having observed with reference to the Prize Wolverhampton Traction Engine, 'What would become of my carriage-horses if they met it on the road?' received for answer, 'Your horses ought not to be allowed on the road until they have been properly broken in, so as to go quietly past my engine.' In fact, wherever the interests of steam-engine and horse came in conflict, he was always in favour of what he considered the superior machine."

His attention appears to have been diverted from his actual business chiefly from his appreciation of the serious loss of time and money which resulted from the slow pace of ordinary agricultural labour, intensified by the ancient and defective construction of the implements of husbandry which were then employed. To use his own words, "the great conservative characteristic of the English farmer—passive resistance to change," made the introduction of improvements a difficult matter 30 years ago. To a man of his temperament "passive

resistance" was simply a stimulant which goaded him to further exertion. He said, "There are, and always will be, people who receive efforts meant to improve their welfare as they do the medicines prescribed by their doctor. A disposition of this sort is inherited with other family traits." How often have I heard him enunciate this dictum, and act upon it too?

I am not competent to follow Mr. Aveling's career as an agricultural engineer, therefore I must content myself with recording the bare facts. Having given up farming, he established works on a small scale at Rochester; in 1856 he introduced the steam-plough to the notice of Kentish farmers, with such success that in 1858 he was presented with a valuable piece of plate, and a purse containing three hundred guineas, by the agriculturists of Kent in recognition of his exertions on their behalf. In his now proper business he scored his first public success by giving self-propulsion to the portable engine. The anomaly of a steam-engine being drawn to the site of its work by six horses he compared to "six sailing vessels towing a steamer," and pronounced, in his characteristic and energetic way, the arrangement as "an insult to mechanical science." In 1859 he took out his first patent to overcome this defect; he exhibited an engine constructed on his own principle at the Royal Agricultural Society's Show at Canterbury in 1860, together with several other agricultural implements, all made by other manufacturers, thus showing that then, although an inventor, he had not become a maker. He was, in fact, an improving dealer and not what, in after years, he was fond of calling himself—a "blacksmith." The catalogue of his Canterbury exhibits was headed by a description of an Eight Horse-power Patent Locomotive Engine, invented by the Exhibitor, manufactured by Clayton, Shuttleworth and Co., Lincoln, "fitted with the Exhibitor's patent arrangement for locomotion and steerage, by which the whole set of machinery may be moved from farm to farm without horses." The Report of the Judges of Implements at that meeting contains the following notice of his stand:—"Thomas Aveling's stand of steam-engines, threshing machines, elevators, horse-gearing, and other machinery, met our very high approval; his universal safety-joint to his driving shafts is worthy of extensive patronage." Although very encouraging to a beginner, it is noteworthy that Mr. Aveling's first attempt to bring into notice a self-moving engine for agricultural purposes was passed over without mention by the Judges on that occasion.

At Leeds, in 1861, Mr. Aveling's exhibits were confined to one of his patent locomotive engines, invented, *improved*, and *manufactured* by the Exhibitor, and to a threshing machine and

straw-elevator by Messrs. Clayton and Shuttleworth. He thus appears for the first time as a manufacturer of his own engine. The following year, at Battersea, he exhibited in conjunction with Mr. Porter, under the style and title of "Aveling and Porter," one of his locomotive engines under the now well-known designation of "Patent Agricultural Locomotive Engine for Threshing, Ploughing, and General Traction Purposes, invented and improved by Thomas Aveling, Rochester, and manufactured by the Exhibitors." No other implement was exhibited by the new firm, and from this year may be dated the commencement of the prosperity of the firm of Aveling and Porter, and the recognition of the value of the invention of the "Father of Traction Engines." Mr. Crosskill remarks that "The assistance which he with his Traction engines rendered to the Judges of Steam-engines at the Oxford Meeting in 1870 will not soon be forgotten by those who were witnesses of it; and it was specially recognised in their Report (see 'Journal' for 1870, Part 2, p. 462). It was, however, always a congenial occupation with him to show the superiority of a Traction engine over Horse-power, in any operation requiring combined strength, docility, and easy management."

The Royal Agricultural Society of England cannot lay claim to having encouraged the use of Traction engines for agricultural purposes, either by offering prizes, or by awarding medals for them until long after their merits had been acknowledged by other public bodies. In 1862, Mr. Aveling, or rather his firm, exhibited their agricultural locomotive engine at the International Exhibition at South Kensington and received a medal for it, but it was not until the year 1871, at Wolverhampton, that the Society publicly recognised the value of an Agricultural Locomotive Engine as a farming implement. At Manchester, in 1869, Messrs. Aveling and Porter first exhibited their Steam Road Roller, which had been invented by Mr. Aveling, and they were awarded a Silver Medal for it as a New Implement. At the present time these rollers are in use in almost every large town in the kingdom, and they are not unfrequently to be seen in continental cities. In 1871, the Society offered a Prize of 50*l.* for the best Agricultural Locomotive Engine, and Messrs. Aveling and Porter carried it off with a Ten Horse-power Engine invented by Mr. Aveling, being Highly Commended in the same Class for their Six Horse-power Engine, and winning a Silver Medal with another Six Horse-power fitted with internal India-rubber Tyres, which were rather the fashion just then. The first-prize engine, although nominally of 10 horse-power, indicated 35 horse-power with a consumption of $3\frac{1}{5}$ lbs. of coal per horse-power per hour. At the same Meeting they obtained

the Prize offered for a Low-sided Trolley to be drawn by an Agricultural Locomotive Engine. At Bedford, in 1874, a Second Prize was won for a Van with Fittings for men engaged in Steam Cultivation. On the Continent of Europe the firm of Aveling and Porter were awarded a large number of medals for the specialities of their manufacture, and some also at American Shows. After the Vienna Universal Exhibition in 1873, Mr. Aveling was decorated with the Order of Francis Joseph; and after the Paris Exhibition, in 1878, he received the Legion of Honour.

This slight sketch of Showyard successes very imperfectly reflects the rapid and enormous growth of the Rochester works, which from very small beginnings have increased to such an extent that for some years an average of 400 men have been constantly employed. It would also be incomplete if I did not notice two of Mr. Aveling's great pets, hobbies I may say, which he originally constructed chiefly to show that steam could be turned to such uses. The two machines taken together may be regarded as a wonderful series of combinations of implements for agricultural purposes.

At the Leicester Meeting in 1868 the firm first exhibited a small Traction Engine fitted with a crane, for which they received a "Commendation." Annually it was placed at the disposal of the Stewards to facilitate the work of getting heavy exhibits into their places. This crane-engine, which soon obtained the nickname of "Little Tom," astonished every one who saw for the first time the ease and celerity with which heavy machinery could by it be picked up at one spot, carried off, and dropped at another. Out of this combination arose one of Mr. Aveling's most original conceptions,—that of a Steam Reaping Machine, for which he was awarded the Gold Medal of the Society after the trials of Reaping Machines at Leamington, held in connection with the Birmingham Show in 1876. This novel machine (a Bell's reaper made by Crosskill, propelled and partially carried by Aveling's crane-engine) performed wonders on ordinary crops, and afterwards it was put by the Judges to cut a heavy crop of wheat on a steep hill-side after a heavy downpour of rain. Mr. Algernon Clarke reported to the Society that "it was weather in which reaping by ordinary machines was impossible; but on all sides of the field, except ascending the steepest gradient, the steam reaper proved itself able to cut. Mr. Aveling, *with that indomitable energy and fertility of resource for which he is famous*, would not be overmastered by even the steep slippery ascent, and by means of spikes on the wheels on the Friday, in the absence of biting irons which were not available until the next day,

succeeded in demonstrating the ability of the engine to climb up the greasy incline without burying the wheels, carrying the reaping machine with her." Here is a practical illustration of two of Mr. Aveling's most prominent characteristics.

Mr. Aveling was elected a Member of the Council in 1875, and immediately made his mark as a man possessing sound common sense, strength of will, and fertility of resource. Elected chiefly on account of his reputation as an agricultural engineer devoted to a branch of the profession which was not then represented on the Council, he was soon afterwards appointed a member of other Committees than the Implement Committee, to which he was naturally nominated in the first instance. It is difficult to say whether he brought more energy to bear upon that Committee or upon the Chemical, the Education, or the Showyard Contracts Committee; but it is quite certain that his name will be most distinctly associated in the annals of the Society with his successful efforts to establish a chemical laboratory belonging to the Society in Hanover Square. His view was that the Council would invest profitably a certain amount of the Society's capital in the building and fitting up of such a laboratory, even if the fees for analysis were reduced to one-half of their previous amounts. Once possessed of the idea, he never rested until the laboratory *was* built; and he spared no pains to elaborate schemes, draw plans, make calculations, and in fact to produce a perfectly workable arrangement, which the Council eventually adopted, to the lasting benefit of the members of the Society.

On the Education Committee Mr. Aveling was equally energetic and characteristic. He hit the great blot on our system of primary education in rural districts by showing that the farm labourers' children are taught a great deal that will be of little use to them in after life as agricultural labourers, with comparatively little that would be of use to them if they followed the vocation of their fathers. He was an earnest advocate for replacing the reading books and diagrams now in use in rural schools by others illustrating agricultural subjects and objects. Few members of Council who were present on the occasion will forget his exhibition of diagrams taken from a Board-school wall, showing that an idea of zoology was sought to be conveyed by means of a picture of the Duck-billed Platypus; the structure of a cow or a horse (he confessed he did not know which), by the exhibition of a picture of the skeleton of an extinct elephant, and so forth. Similarly, he showed the inapplicability of the existing text-books to the education of children in agricultural districts, and asked why a dog, a cat, a cow, a sheep, and a horse should not be as good

illustrations of natural history as lions, bears, and other exotic animals. His suggestion that the Council should endeavour to encourage the publication of reading books and diagrams of a more practical nature will probably be carried out in some way at a future time.

On the Continent, Mr. Aveling's merits as an inventor of road-rollers and traction engines were perhaps more thoroughly recognised by Governments and public bodies than they were in his own country. He received the Austrian Order of Francis Joseph in 1873, and the French Legion of Honour in 1878, besides an immense number of Gold and Silver Medals, awarded during a period of twenty years by representative bodies of most European and some American States.

In politics Mr. Aveling was an advanced Liberal, but his opinions on these as on other subjects never interfered with his instinctive sense of right and wrong. He judged every question according to the dictates of his conscience and the power of his intellect, entirely unfettered by any question of party. I do not believe that he would have altered an opinion or abandoned a course of action, except from conviction, under any circumstances whatever.

In private life Mr. Aveling was much beloved by his family and friends, and by the majority of his workpeople, which is saying a great deal in these days. Strict as a military martinet in business hours, and exacting to the utmost as to the manner in which work should be done, he necessarily kept only the best men, and many of these have been in his employment for several years, some even ever since he commenced business. But outside the workshop he was never tired of giving them opportunities of healthful and improving recreation.

In this as in all other matters Mr. Aveling was eminently practical; and as an illustration of his character as well as a record of the good that he did to his workmen it may be allowable to indicate some of his labours on their behalf. He fitted up a part of the old works at Rochester as a lecture-room for his men, and he and others read papers and delivered lectures there on educational, social, and political subjects. Afterwards Mr. Aveling invited discussion, for he generally occupied the chair. At first the men delivered speeches of the most communistic type, but after a time they became capable of looking at questions from a different point of view. Mr. Aveling was always careful that they should hear arguments well put by educated men, after having first encouraged the workmen to express their own opinions. He used to say, "There is nothing to fear from Radicalism, and I don't object to it; but there is a great deal to fear from uneducated Radi-

calism, and that I do object to." In this way, various social and political subjects were ventilated, and as a result his workmen abandoned such communistic doctrines as compulsory subdivision of land, and other visionary ideas. Everybody was free to attend these meetings, and sometimes farmers and farm-labourers took part in the discussions. Mr. Aveling, in fact, devoted a great deal of time, and spared no expense "to let a little daylight" into his workpeople, and it is impossible to estimate the amount of good that he did in this way alone. It is almost needless to say that he was roundly abused by the "unco' guid" for what he did in this direction, and some people tried to hold him responsible for all the ideas which were broached during these discussions. I cannot recall any *verbatim* statement of his on this result of his endeavours, but all he said doubtless amounted to, "It pleases them, and it doesn't hurt me."

The domestic comfort of his men he regarded as very important; and as an illustration of the value which he placed upon it, I may mention that he erected a large and comfortable mess-room, fitted with cooking-stoves and other means and appliances. Here he had a man to look after and keep hot the food that was brought there for the men's meals. This may seem a small matter on paper, but it made a vast difference every day in the comfort of the men, and therefore of their capacity for work. This room was always at the disposal of the "Foresters" or any other club which desired to use it for meetings;—"anything rather than let them go to a public-house."

Mr. Crosskill states that "amongst his favourite recreations were listening to good music and playing at chess. Before he became a Member of Council, and actively engaged in the Showyard management, he delighted in a quiet game at the back of his shed; and even of late years he would, if possible, snatch an hour for that purpose from his numerous avocations. I well remember the astonishment of two of his colleagues, who had known him only as an active and vigorous worker, coming unexpectedly upon him thus occupied, one afternoon during the Carlisle Show. On his yachting expeditions there was, of course, plenty of time and opportunity, and a travelling chess-board was an indispensable portion of his equipment."

His greatest enjoyment, indeed, was yachting, and he took as active a part in the management of the Royal Victoria, the Royal Cinque Ports, and other Yacht Clubs of which he was a member, as he did in the business of those Societies connected with the more serious occupations of his life. Several years ago he possessed a small six-ton cutter, which he called

the 'Sally,' after his wife. She was run into and nearly cut in half by a steamer one evening when he was playing cribbage with his son. The latter escaped on board the steamer, and Mr. Aveling's life was saved by a boatman and half a bottle of brandy. He was an excellent swimmer, and when his yacht was run into he supported himself in the water for some time, shouting for aid. At last he was picked up by a boatman when just about to sink from exhaustion, but still clutching his "hand" of cards. Fortunately the boatman had seen amongst the wreck and had picked up a wine bottle, which, on being opened, he found to contain brandy. This he poured down the throat of the almost expiring man and no doubt saved his life. If the bottle had been full it would have sunk, and most probably Mr. Aveling would not have recovered for want of the stimulant at the critical moment. Both father and son thought that the other was drowned. This was not by any means the only adventure that nearly cost Mr. Aveling his life, and I mention this one merely as an example. The fact is he did not know what *fear* meant. It is narrated of him that he once saw a steam ploughing-engine, doing very heavy work, on the point of bursting—the steam oozing out between the boiler-plates in all directions; he said to his cousin, Mr. Stephen T. Aveling, who was with him at the time, "Look at that fool trying to burst that engine!" Then coolly walking up to it, he asked the engine-driver whether he had a wife and family; and on being told that the man had a wife and five children to support, he remarked, "If you were a single man, of course you could do as you liked; but with a wife and five children depending upon you, you have no right to risk your life in this foolhardy fashion, and if you don't take that weight off the safety-valve of your engine, your wife will soon be a widow." Mr. Stephen Aveling tells me that he did not realise until some time afterwards the risk they had all run during this dialogue. Mr. Aveling much admired fearlessness in other people. I recollect, at Plymouth, on one occasion we saw a fine strong labouring man deliberately cross the road at a slow pace in front of a carriage and pair coming down a steep hill. The coachman and the footman both shouted, the bystanders shouted, I stood aghast, and Aveling had a broad inquiring smile on his face, with his eyebrows elevated. By dint of great exertions on the part of the coachman the man was just *not* run over. I thought he was deaf, but as he approached us he gave a deliberate wink! Mr. Aveling ejaculated, "That's the coolest thing I ever saw! That's a lazy vagabond who would like to get into the hospital and be paid for being there!"

Want of space deters me from giving any of our yachting experiences, but even yachting with him was not an idle amusement. There was always something to be done; fishing or racing, or trying to win shilling bets by all sorts of recondite means, wild-fowl shooting at different haunts, chess, draughts, cards, and an infinity of other devices always made life on board the 'Sally'—a new yacht of 28 tons,—anything but monotonous.

It was on board this yacht that he caught the chill which produced his fatal illness. He was not seriously indisposed until Monday, February 27th, and to the great grief of all who knew him, he died of pneumonia quite peacefully on Tuesday, March 7th, in his fifty-eighth year—a man "*sans peur et sans reproche.*"

XVIII.—*Annual Report of the Consulting Botanist for* 1881. By W. Carruthers, F.R.S.

Applications for advice as to pastures were more numerous during the past year. I have advised members as to the best kinds of grasses to be employed for reclaimed lands, and for cultivated lands proposed to be laid down in pasture. The careful observations of one of the members, Mr. Faunce-De Laune, of Sharsted Court, with whom I have been in frequent communication, and his practical success in selecting suitable grasses, and laying down perennial pastures which supply a continuous and nutritious food for stock, are of great importance.*

Nearly eighty samples of grass seeds have been examined by me for their purity, and tested for their germinating power. The results of these investigations have been, on the whole, satisfactory, except in some cases of mixtures in which I have found a great preponderance of vigorous annual grasses of little value for permanent pasture. Better samples of meadow foxtail (*Alopecurus pratensis*) have passed through my hands, though the proportion of good seeds is still very small in this grass. Some of the smaller grass-seeds that I have examined have been exceptionally bad. A parcel, for instance, of fiorin (*Agrostis stolonifera*) consisted entirely of empty chaff or of unripe seeds incapable of germination. I have also had submitted to me almost worthless samples of rough-stalked meadow-grass (*Poa trivialis*) and crested dog's-tail (*Cynosurus cristatus*). I am satisfied that the annual loss to the country (necessarily implying a loss to the farmer) is very great from sowing bad grasses and worthless seed of good grasses. It

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* *Vide* pp. 229 *et seq.*

would effect a great improvement if cultivators were to discontinue using prepared mixtures, and purchase the grasses they propose to sow in the proper proportions, and mix them themselves. It is very easy to test their germinating power. This would, as far as it goes, supply data for determining the value of the seed purchased.

Clover seeds have been very satisfactory. This seed is, as far as my experience goes, entirely free from the adulterations which were once so common. A sample of white clover (*Trifolium repens*) was sent to me which contained so large a proportion of immature seeds that scarcely half of the sample germinated.

The samples of seed grain have been generally good. The previous season did not favour the production of a superior quality, but the seeds were healthy and the germinating power high. I met with one striking exception in a small sample of "naked oats." The sample consisted of two-thirds of a white oat and one-third black oats, and there was a considerable quantity of the following weeds:—cleavers, mustard, pepperwort, corncockle, and climbing buckwheat. The grains of oats were imperfectly filled, and the germinating power was only 40 per cent. A second sample of the same oats, sent to me by the owner, though more true to the variety, and almost free from weeds, was yet very defective in its germinating power.

The increasing demand for determining the germinating value of the various seeds has led me to introduce a large and improved apparatus into my Laboratory, with the view of more efficiently carrying on this work.

I prepared a report on the results of the competition for prizes offered by the Society for improved wheats, which was published in the last volume of the 'Journal.'

The prevalence of parasitic fungi on the cereal crops has engaged my attention. I have examined and reported on several specimens forwarded to me. In the end of August, I visited a district in the north of Cambridgeshire, where mildew had suddenly appeared, and done great injury to the crops. By the kind assistance of Mr. Little, March, I was able to examine a considerable extent of crop. The results of this investigation, together with an account of the fungus which produces the blight, will form the subject of an article for an early number of the 'Journal.'

Samples of ear-cockle or pepperbrand have been forwarded to me. This disease has, in some localities, been severe. It is caused by the attack of a very minute thread-worm on the growing point of a young flower in the earliest stage of its existence. The flower is converted into a gall, filled with a

great number of these worms, which have been developed in the gall, and form a white cotton-like mass in its centre.

Sufficient care is not taken to destroy these worms. When the gall is sown with the seed, the moisture of the soil revives them; they escape from the gall, and find their way to the flowers of the growing crop. I have treated of this disease at some length in this number of the 'Journal.'*

Several cases of weeds proving injurious to stock have been submitted to me, on which I have reported. A remarkable case of injury to vegetation from a minute alga (*Pleurococcus vulgaris*) was brought under my notice. This microscopic plant developed in the mould of the hotbed from which I obtained it with such marvellous rapidity that it completely covered all the particles of the mould, and so prevented the terminations of the rootlets obtaining nourishment from the soil.

Serious injury was done to a young crop of mangolds by the burrowing of the larva of *Anthomya Betæ* in the leaves.

A field of wheat suffered from the larva of *Chlorops lineata*, which attacked the tender ear, and destroyed it.

XIX.—*Report of the Consulting Botanist on Laying down Land to Permanent Pasture.*

[Presented to the Council at their Meeting on February 1, 1882.]

In determining the grasses best fitted for laying down land in pasture, it is important to take into consideration the term of life of the different species.

Many grasses are so short-lived that they do not survive the exhaustive process of seeding. One-third of our indigenous grasses die in this way, usually at the close of a single season, and are therefore called annual grasses. Not only the portion of the plant above ground, but the roots also perish, and the species is preserved from year to year only by the seed. The remaining two-thirds are grasses in which the process of flowering does not so completely exhaust the plant as to kill it. The life of the individuals in these grasses is continued from year to year, and seeds are annually produced. Though the plant may be killed down by the winter's cold, the roots, with their crown, remain alive, and increasing in their hold on the soil, are able to secure a more speedy and extensive growth than can be produced under the most favourable circumstances from seeds.

While annual grasses, or those having a short term of life, like

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* *Vide* pp. 346, *et seq.*

the rye-grasses, may be specially fitted for alternate husbandry, it is obvious that permanent pasture should be formed by those grasses which have a perennial existence.

But the eighty species of indigenous perennial grasses are not all suitable for feeding purposes; many of them are rejected by stock. It is therefore necessary to make a selection from them in accordance with the tastes of the animals for which they are provided. And, further, it has been long noticed that some pastures which appear to consist of an abundant supply of good food, are yet unable to fatten stock. This must limit the selection of the grasses to those which, by experiment and observation, have been found to be nutritious as well as palatable.

A prejudice exists against some grasses, which are supposed to be coarse, and are therefore rejected, when finer grasses can be obtained by the stock. But the chemical examination of some of these coarse grasses, and the careful observation of their effect on the stock, have shown that the grasses which are most productive are also those that are most nutritious.

The number of these species is very limited. The observations of Mr. Faunce-De Laune, which are supported by the testimony of previous careful observers, show that the best permanent pasture grasses are the following five species:—*Dactylis glomerata* (Linn.), or cock's foot; *Phleum pratense* (Linn.), or timothy; *Alopecurus pratensis* (Linn.), or meadow fox-tail; *Festuca pratensis* (Huds.), or meadow fescue; and *Festuca elatior* (Linn.), or tall fescue.

These five grasses alone would supply favourite and nutritious food throughout the whole year.

There should be added some Dutch and perennial red clovers. And some of the smaller, or so-called finer, grasses would be advantageously introduced in order to secure a compact turf—such grasses as *Poa nemoralis*, *Poa trivialis*, *Agrostis stolonifera*, *Cynosurus cristatus*, *Anthoxanthum odoratum*, and *Festuca duriuscula*. But the real value of the pasture will depend upon the proportion of the five larger grasses which are found in it. Their first importance is still further shown by the fact that their roots continue to grow from year to year, and the plants consequently get a firmer hold on the soil, and, having a more extensive root system than annual grasses, they suffer less from drought.

The exclusion of the short-lived rye-grasses, which are so overwhelming an ingredient in all permanent pasture mixtures in the market, will deprive the farmer of that speedy exhibition of a green and vigorous pasture so captivating to the eye, and so often accepted as the best testimony to the value of the

mixture employed, but so worthless as the basis of a permanent pasture.

It would be an important step in advance if the farmer were to become acquainted with the value and permanence of the best grasses, and see in their growth the best guarantee for his future crop, even though they want the beautiful appearance that a field of young rye-grass presents.

The species of grass for permanent pasture having been fixed upon, it is of next importance to obtain true, pure, and good seed. The prepared mixtures should be avoided, not only because they contain species not suited for permanent pasture, but also because they cannot be made the subject of careful determination as to purity and goodness.

A guarantee should be obtained from the merchant that the quantity purchased is true to the species wanted and specified, that it is free from weeds, and that a certain percentage of the seeds will germinate. Samples from the bulk should be examined and tested by a competent person, and the completion of the purchase should depend upon the result of this examination and trial.

The seed should not be left on the surface of the ground, else it may not secure the moisture necessary for its germination, or when it has begun to germinate, and the delicate embryo has pushed its roots and stem through the covering of the seed, a continuous exposure of a few hours to the hot rays of the sun may kill it. On the other hand, if the seed be too deeply buried in the soil it will fail to germinate. A depth of from half an inch to an inch and a half is most suitable for the grasses that should be employed for permanent pastures.

XX.—*Laying down Clay-land intended for Permanent Pasture.* By C. Randell, of Chadbury, Evesham.

[In a Letter to the Consulting Botanist.]

A succession of unfavourable seasons affecting this description of land more than any other has forced upon landlords the consideration of the desirability of getting rid of the cost of cultivating such lands by laying it down to grass. This applies mainly to untenanted farms, for where tenants have continued in the occupation of farms consisting largely of heavy land, and have tried, in spite of adverse seasons, to keep up the condition of it, they have no desire to lay such land down to grass, unless it be an exceptionally bad piece. They know that with a return of better seasons all moderately good clay-land will pay

them better in cultivation than in grass, and will carry more stock while consuming green crops such as vetches, clover, cabbages, rape, and mangold, alternately with wheat, barley, and beans, than it would do in permanent pasture.

But there are a great number of clay-land farms which have been given up to their owners in wretched condition. The tenants have impoverished their land and themselves by holding on as long as they were able—hoping against hope—and leaving their landlords no alternative but to endeavour to restore these farms to such condition as would be likely to attract new tenants, a costly proceeding any way; but it would appear that the most likely way to attain the object is to lay down a large portion of such farms to grass. How is this to be done?

I assume that the land is drained. This is an absolute necessity. Obviously then the first thing is to get it clean from couch-grass; and if, as was the case this year (1881), this can be effected by the aid of steam in June, and there be a sufficiency of rain afterwards to get a fine natural tilth in July, the grass seeds may then be sown; and if aided by 5 cwt. per acre of fish guano, containing 8 to 10 per cent. of ammonia, and 35 per cent. of phosphates, or the equivalent thereto, the grass seeds will be established before winter. It may be that they will require to be eaten off carefully in September. If the land cannot be got ready for the seeds by the end of July, the sowing will be done in the following spring without a corn crop upon a stale furrow, merely scarifying the land to get rid of surface weeds. The mixture which I have used is—1 bushel cocksfoot (to 1½ bushel according to percentage of growth), ½ bushel perennial rye-grass, 6 lbs. cow-grass, 2 lbs. Dutch clover; the percentage of growth guaranteed being, cocksfoot 40, rye-grass 70, cow-grass 80, and Dutch clover 80. This mixture cost last spring less than 15*s.* per acre, but the prices advanced before the close of the season, and are now still higher. Having secured the plant of grass, the next consideration is how to treat it; and here my view will be opposed to those generally entertained. The prevailing idea is that no sheep should be allowed to go upon newly laid down land. I would have no other stock for the first three years; but in this way. Assuming that the seeds were sown in July, the tilth and the weather favourable, they should be so strong in September as to require to be eaten down, otherwise they would be liable to injury from frost before spring. This should be done by lambs *folded* upon them, and getting as much space twice a day as they will eat level, with an allowance of oilcake, malt-dust, and clover-chaff, the back hurdles being moved every second day to prevent the lambs biting off again the young seeds

as they spring, and they must not be upon them in wet weather; to avoid this there must be a field of turf or old seed to take them to when their treading would injure the young seeds. In the following spring these young seeds should be folded off by ewes and lambs, the latter going forward by the aid of lamb-gates, and both getting pulped mangolds mixed with chaff and oilcake (linseed and cotton-seed cake mixed); the back hurdles should be frequently moved, for two reasons—first, that the land should be equally manured; second, that the young shoots of the grasses be not eaten down again immediately. A second folding may be made with yearling ewes, a third with the general flock, each lot receiving ½ lb. cotton-cake daily, but none kept on the land after October. If this treatment be repeated the third year, the turf will be established, but the less it is stocked during winter for several years the better. If a crop of corn is taken the first year, which would usually be the case in the hands of a tenant, the same method should be adopted in eating off the young seeds, but it will not often happen that they require to be fed off after harvesting the corn crop; if they do, it should be by *folding*, not turning sheep into the whole field. All this requires attention, and involves cost, but let no one suppose that a turf of any value can be obtained on clay-land without considerable cost. It may be obtained by repeated applications of manure, mowing, and grazing by young cattle; but this will be more expensive than the employment of sheep; they will repay directly and indirectly the cost of all the food and labour bestowed upon them, and in the way indicated a good turf may be obtained.

I know that what will more frequently happen is that the seeds will be sown with a corn crop without manure, and that they will be grazed by sheep and other stock in the ordinary way, with this result—they will carry a moderate amount of stock the first year, very much less the second, still less the third: by that time the sown grasses will have died out, and for several years the pastures will be all but worthless, and nothing gained but getting rid of the expense of cultivation. Manuring may strengthen the natural grasses, and after a time enable the land to carry store stock, but for the sort of land in question I think the treatment I have described will be found eventually the most satisfactory.

XXI.—*Quarterly Reports of the Chemical Committee*, 1881.

March, 1881.

In presenting the following Quarterly Report on cases which the Consulting Chemist has brought before them, the Chemical Committee wish once more to draw the attention of the Council to the difficulty which they experience in obtaining from members of the Society the names of the makers and vendors of inferior or adulterated manures and feeding stuffs. Too many members seem to be of opinion that the Reports of the Chemical Committee are issued to enable them to obtain a reduction of price by means of a threat to send the names of the vendors to the Society for publication. The Committee desire to make it known that their publishing cases in the Quarterly Reports is to show members of the Society the danger of purchasing manures and feeding stuffs under indefinite names, and without guaranteed analysis; and that they do not attempt to screen any member from the result of his own disregard of their recommendation to buy under definite names, and with a guaranteed analysis.

Dr. Voelcker reported the following cases:—

1. A sample of linseed-cake sent by Mr. Charles Clarke, Ashby-de-la-Launde, Sleaford, on analysis showed the following composition:—

Moisture	14·99
Oil	10·60
*Albuminous compounds	23·81
Mucilage, starch, and digestible fibre	32·87
Woody fibre (cellulose)	11·33
†Mineral matter (ash)	6·40
	100·00
* Containing nitrogen	3·81
† Containing sand	1·99

This cake, it will be seen, is poor in albuminos compounds, and it contained starchy matter, which should not be present in pure linseed-cake.

In reply to the usual inquiries, Mr. Clarke wrote as follows:—

"Ashby-de-la-Launde, Sleaford, February 24th, 1881.

"Dear Sir,—In answer to your letter and wishes, I beg to say I would rather not disclose the name of the firm I bought the cakes of, as I have had several lots before analysed which proved that I was getting a fair cake, and I really did get a letter from the gentleman concerned in the making of the cakes you analysed, which proved that I had just cause to complain, 'and so the matter dropped.' I shall be sending you another sample or two soon.—Yours very truly,

"Charles Clarke."

2. Mr. George Martin, Hubert's Bridge, Boston, sent two samples of linseed-cake for analysis. The cakes marked No. 1 and No. 2 respectively had the following composition :—

	No. 1.	No. 2.
Moisture	12·60	14·30
Oil	7·75	11·05
*Albuminous compounds	25·62	24·25
Mucilage, sugar, and digestible fibre	36·38	33·89
Woody fibre (cellulose)	8·66	11·01
†Mineral matter (ash)	8·99	5·50
	100·00	100·00
* Containing nitrogen	4·13	3·88
† Containing sand	4·49	·40

No. 2 was a good linseed-cake. The cake marked No. 1, it will be seen, was poor in oil, and made from dirty linseed.

Mr. Martin wrote on the 14th of January, 1881 :—

"I am very much surprised at the analysis of No. 1 linseed-cake, which was bought as pure, and from a firm professing a great deal of purity. The price was 9*l.* 12*s.* 6*d.* in Hull, making it 10*l.* 2*s.* 6*d.* at my station; No. 2 price at my station would be 9*l.* 17*s.* 6*d.* I mean to claim 20*s.* per ton compensation on No. 1 cake."

This claim was eventually paid, and Mr. Martin declined to give the name of the vendor.

3. A sample of artificial manure manufactured in Jersey, and said to contain blood, bone, guano, &c., was sent for analysis by Mr. W. M. Jones, Guernsey. The manure had the following composition :—

Moisture	25·40
*Organic matter	21·60
Phosphate of lime	8·25
Carbonate of lime	11·01
Oxide of iron and alumina, &c.	4·94
Insoluble siliceous matter (sand)	28·80
	100·00
* Containing nitrogen	1·80
Equal to ammonia	2·19

This manure was sold as "Engrais artificiel" (artificial manure) at 7*l.* 10*s.* in Jersey, or 8*l.* per ton delivered in Guernsey.

The maker asserted that the manure was as rich as Peruvian guano, and more concentrated than in previous years.

It will be seen, however, that it contained only 8¼ per cent. of phosphate of lime, and 2 per cent. of ammonia in round numbers. On the other hand, it was damp, and about three-quarters of its weight consisted of moisture and useless earthy and other matters.

The manure would have been rather dear if, instead of 8*l.* per ton, it had been sold at 3*l.* per ton.

Mr. Jones, in reply to further inquiries, wrote on the 15th of February, 1881, as follows:—

"To-day the manufacturer came over from Jersey, and protested that he had put guano, superphosphate, blood, and dissolved bones with this mixture, which was the last he is ever to make, owing to the stench complained of in the use of blood. I showed him your valuation.

	£	*s.*	*d.*	
"Such being the case he took off	4	0	0	for the 2 tons,
and paid freight, charges, and your analysis	1	13	4	
	5	13	4	

"As no public end is to be served in publishing his name, which I shall do myself if he continues his business, I have to request that this be perfectly confidential between the Society and myself.

"I have no objection to the facts being used to warn those who buy without analysis.—I am, dear Sir, yours faithfully,

"W. M. Jones."

June, 1881.

1. Mr. Robert Thompson, Mythop Lodge, Blackpool, sent a sample of artificial manure for analysis on the 18th of April, 1881, which had the following composition:—

Moisture	16·01
*Organic matter and salts of ammonia	23·54
Monobasic phosphate of lime	9·89
Equal to tribasic (bone) phosphate of lime ..	(15·48)
Insoluble phosphates	5·03
Sulphate of lime, alkaline salts, magnesia, &c.	39·30
Insoluble siliceous matter	6·23
	100·00
* Containing nitrogen	2·14
Equal to ammonia	2·59

The manure was bought as extra top-dressing at 10*l.* 5*s.* per ton, with the following printed guarantee:—

13 to 17	per cent.	soluble phosphate
3 „ 6	„	insoluble phosphates
13 „ 18	„	potash and magnesia salts; and nitrogen equivalent to
14 „ 18	„	sulphate of ammonia, or
17 „ 22	„	nitrate of soda.

Fourteen per cent. of sulphate of ammonia, the minimum quantity guaranteed, contains 3·6 per cent. of ammonia, or 1 per cent. more than was found in the sample analysed by Dr. Voelcker; the percentage of soluble and insoluble phosphates satisfy the demands of the guarantee, it being understood that the lower figures alone are binding. Attention also is directed to the statement that the vendor guarantees nitrogen equivalent to a minimum of 14 per cent. of sulphate of ammonia, or 17 per cent. of nitrate of soda, but not both together.

Measuring its value by the minimum figures quoted above, this manure is not worth more than from 5*l.* 5*s.* to 5*l.* 10*s.* a ton.

2. Mr. Robert Lake, Oakley, Rochester, sent Dr. Voelcker a sample of British guano, of which he bought, without a guarantee, two tons at 3*l.* per ton from Messrs. Jones and Co., Mark Lane, manufacturers.

The following is the composition of this sample of British guano:—

Moisture	15·15
*Organic matter	31·55
Phosphate of lime	2·84
Oxide of iron and alumina	4·25
Carbonate and sulphate of lime, &c.	27·83
Insoluble siliceous matter	18·38
	100·00

* Containing nitrogen	1·50
Equal to ammonia	1·82

A better manure than this British guano would be obtained by adding 25 per cent. of mineral superphosphate to one ton of shoddy. Good shoddy, yielding from 5 to 6 per cent. of ammonia, can be bought at about 50*s.* to 60*s.* per ton; and superphosphate, guaranteed 25 per cent. soluble phosphate, at 4*l.* per ton.

Accordingly, one ton of shoddy, costing 50*s.*, and 5 cwt. of superphosphate, costing 20*s.*, will give a manure which costs 2*l.* 16*s.* per ton, and which contains about 5 per cent. of ammonia and 6 per cent. of soluble phosphate of lime. In other words, one ton of the mixed shoddy and superphosphate would be worth fully as much as two tons of British guano.

3. Mr. Robert Lake also sent a sample of Davis's Patent Manure, of which he bought three tons at 6*l.* per ton from Messrs. Henry Wright and Son, Town Wharf, Maidstone, agents in Kent for Davis and Co.'s Patent Manures.

On analysis, the sample sent by Mr. Lake showed the following composition:—

Moisture	3·45
Sulphur	1·90
*Organic matter and water of combination ..	9·20
Oxides of iron and alumina	7·40
Phosphate of lime	0·44
Sulphate of magnesia	8·29
Sulphate of lime	23·01
Sulphate of soda	13·26
Sulphide of soda and common salt	23·01
Insoluble silicious matter	10·04
	100·00
* Containing nitrogen	0·44
Equal to ammonia	0·53

This manure appears to consist mainly of lime-refuse and alkali-waste or salt-cake, and as it contains only about ½ per cent. of phosphate of lime and the same amount of ammonia, it has little value as a manure.

4. Mr. Charles Whitehead, Barming House, Maidstone, also sent a sample of Davis's Patent Manure, of which he bought 1 cwt. at 7*s*., price 6*l*. per ton, from Messrs. H. Wright and Son.

The following is the composition of the sample sent by Mr. Whitehead :—

Moisture	4·20
Sulphur	4·80
*Organic matter and water of combination ..	6·01
Oxide of iron and alumina	4·82
Phosphate of lime	2·38
Chloride of sodium	8·75
Sulphate of soda	6·43
Sulphate of magnesia	8·35
Sulphate of lime	24·48
Sulphite and a little carbonate of lime	24·83
Insoluble siliceous matter	4·95
	100·00
* Containing nitrogen	0·59
Equal to ammonia	0·72

Like the sample sent by Mr. Robert Lake, that sent by Mr. Whitehead consists principally of lime-refuse and alkali-waste or salt-cake, and is worth very little as manure.

The two samples differ somewhat in composition; thus, the sample sent by Mr. Robert Lake contained only 1·90 per cent. of free sulphur, and under ½ per cent. of phosphate of lime, and about ½ per cent. of ammonia; whereas Mr. Whitehead's sample contained 4·80 per cent. of free sulphur, 2·38 per cent. of phosphate of lime, and about ¾ per cent. of ammonia. Uniformity

of composition can hardly be expected in a material which, like Davis's Patent Manure, consists largely of manufacturing refuse matters.

December, 1881.

The Committee beg to report the following cases which have been brought under their notice by the Consulting Chemist:—

1. Mr. Richard Bettinson, Thurlby, near Bourn, Lincolnshire, sent a sample of a lot of two tons of bone-dust, supplied on the 28th of June, by a Manure Company, at 9*l.* a ton, and invoiced as bone-dust.

The following is the composition of the sample sent by Mr. Bettinson:—

Moisture	12·50
*Organic matter	14·81
Phosphate of lime	55·69
Sulphate of lime, magnesia, and alkaline salts	15·09
Insoluble siliceous matter	1·91
	100·00
* Containing nitrogen	1·23
Equal to ammonia	1·49

Good bone-dust made from raw or green bones contains from 46 to 48 per cent. of phosphate of lime, and yields about 4½ per cent. of ammonia. It is worth from 7*l.* 15*s.* to 8*l.* a ton.

The sample analysed for Mr. Bettinson yielded about 8½ per cent. more phosphate of lime than ordinary bone-dust, but only 1½ per cent. of ammonia.

Bone-dust is a recognised trade name for ground "raw" bones.

It appears from the preceding analysis, that the sample sent by Mr. Bettinson was not *raw* bone-dust, but *boiled* or glue-maker's *refuse* bone-dust, which is worth about 1*l.* less per ton than raw bone-dust. Boiled or steamed bones of the quality of the sample sent by Mr. Bettinson are worth about 6*l.* 5*s.* at the works where they are produced. This case is published to show the necessity of purchasers insisting upon a full and accurate description of their purchases in the statements sent to them by the vendors.

2. A manure, described as Special Turnip-manure, and sold at 3*l.* 15*s.* per ton, and 15*s.* carriage, or 4*l.* 10*s.* delivered, was purchased by Mr. Thomas Thursfield, Barrow, Broseley, without guarantee.

A sample of this manure, on analysis, had the following composition:—

Moisture	15·50
*Organic matter and salts of ammonia	24·80
Phosphate of lime	3·69
Oxide of iron and alumina	7·31
Sulphate of lime	20·79
Alkaline salts and magnesia	2·87
Insoluble siliceous matter (sand)	25·04
	100·00
* Containing nitrogen	1·56
Equal to ammonia	1·89

This manure, it will be seen, is poor in phosphate of lime and in ammonia, and scarcely worth *2l.* 2*s.* per ton, delivered on the farm.

3. Mr. John N. Waite, Bramerton, Norwich, sent me a sample of turnip-manure, which, on analysis, was found to have the following composition:—

Moisture	18·01
*Organic matter	1·20
Phosphate of lime	13·76
Sulphate of lime	11·32
Oxide of iron and alumina, &c.	18·81
Insoluble siliceous matter (sand)	24·90
	100·00
* Containing nitrogen	0·79
Equal to ammonia	0·96

This manure, it will be noticed, contained a large proportion of sand and useless earthy matter, only $13\frac{3}{4}$ per cent. of phosphate of lime, and not quite 1 per cent. of ammonia. In Dr. Voelcker's opinion it is hardly worth 2*l.* 10*s.* per ton. It was sold to Mr. Waite at 6*l.* 10*s.* per ton, cash, without guarantee.

Mr. Waite bought 2 tons, and paid cash (13*l.*) to the manufacturer, who on being asked for the usual discount of 10 per cent. for cash payment, informed Mr. Waite that he could not afford to give discount, as his manure was so well made that he ought to sell it at a higher price.

4. The following is the composition of a sample of adulterated guano sent to Dr. Voelcker by Mr. James Harris, Felthamstead, Coventry:—

Manure	5·75
*Organic matter, and salts of ammonia	18·21
Phosphate of lime	10·35
Carbonate of lime	31·48
Alkaline salts and magnesia	16·91
Insoluble siliceous matter	17·30
	100·00
* Containing nitrogen	0·84
Equal to ammonia	1·02

This guano was largely adulterated, and not worth more than 2*l.* per ton. It was guaranteed to contain 9¾ per cent. of ammonia, and its price was 12*l.* per ton for cash. In reply to the usual application for the vendor's name and address, Dr. Voelcker received the following letter from Mr. Harris:—

"Fletchamstead, Covéntry, Nov. 19th, 1881.

"DEAR SIR,—In reply to yours of the 16th inst., I showed your valuation of the so-called guano, and the person I purchased it of took all back I had left, and returned me the money for what I had used. So I considered the affair settled."

5. A sample of nitrate of soda, bought by S. J. Knight, Greenfields, Horley, Surrey, at 16*l.* per ton, had the following composition:—

Moisture	2·55
Chloride of sodium (common salt)	38·75
Other impurities	0·33
Pure nitrate of soda	58·37
	100·00

The nitrate of soda, it will be seen, was shamefully adulterated with common salt, and on comparison with good commercial nitrate, containing 95 per cent. of pure nitrate of soda, worth only 9*l.* 16*s.* per ton.

No information respecting the dealers of the adulterated nitrate could be obtained.

6. Another sample sold as nitrate of soda to Mr. Joseph Walls, of Wrotham, was found to consist of:—

Water of crystallisation, and moisture	56·20
Sulphate of soda	43·80
	100·00

It contained no nitrate whatever, and was simply crystallized sulphate of soda, or Glauber salts.

In reply to the usual inquiries, Mr. Wall wrote as follows:—

"Wrotham, Dec. 3rd, 1881.

"My object really was simply to ascertain if the article is of any manurial value, and if safe to use on the land. It was represented to be pure nitrate of soda. I paid a deposit on it, which, if it is what is known as washing soda, amounts to about its value. The party who sold it to me, I find, is not worth powder and shot, so that I would not care to spend money upon him, but should he press for further payment I shall be glad to avail myself of your assistance.—I am, dear Sir, yours truly,

"JOSEPH WALLS.

"H. M. Jenkins, Esq."

7. A sample of linseed-cake, sent by Mr. Henry W. Grimes, Scarliffe Grange, Chesterfield, was found to be adulterated with

starchy mill-refuse and made from dirty seed. The only information which could be obtained with respect to this case is embodied in the following letter:—

"Dear Sir,—The vendor of the linseed-cake is a friend of mine, and I do not wish to proceed further; the answer to any other question I know would be of no use to you. I have made my own private use of your analysis.—I am, yours very truly,

"Henry W. Grimes.

"Dr. A. Voelcker."

The Committee again express their regret that many members of the Society, who send samples for analysis, will not furnish the names and addresses of the dealers.

ADDITIONS TO THE LIBRARY IN 1881.

I.—PERIODICALS PRESENTED TO THE SOCIETY'S LIBRARY.

Presented by the respective Societies and Editors.

A.—English, American, and Colonial Periodicals.

Agricultural Economist. Vol. XII. 1881.
——— Gazette. 1881.
——— Almanack. 1882.
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——— Statistics, Ireland, 1881.
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Athenæum. 1881.

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Bell's Weekly Messenger. 1881.
Bristol Mercury. 1881.

Chamber of Agriculture Journal. Vols. XXIV. and XXV. 1881.
Chemico-Agricultural Society of Ulster, Journal of. Vol. XV. 1881.
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Coates's Herd Book. Vol. XXVII. 1881.
Country Gentleman. Vol. XIX. 1881.

Devon Herd Book. Vol. VIII. 1881.

Economist. Vol. XXXIX. 1881.
English Cart-horse Stud Book. Vol. I.
Essex Standard. Vol. LI. 1881.

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———, Proceedings of the. 1881
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Royal United Service Institution, Journal of the. Vol. XXXV. 1881.

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———. Miscellaneous Collections. Vols. XVIII., XIX., XX. and XXI. 1881.
Society of Arts, Journal of the. Vol. XXIX. 1881.
Statistical Abstract for the United Kingdom from 1866 to 1880.
——— Society, Journal of the. Vol. XLIV. Parts I.—IV. 1881.

Tasmania. Statistics of the Colony of. 1881.

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Trade and Navigation of the United Kingdom, Accounts relating to the, 1881.
Veterinarian, The. Vol. LIV. 1881.
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B. List of Foreign Periodicals.

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——. —————— ————. Band X. Hefte 1–6, and Supplement. 1881.
——. Journal für Landwirthschaft. 1881. Hefte 1 and 3.
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Heidelberg. Verhandlungen des Naturhistorisch-Medicinischen Vereins. Neue 3. Folge, 11te Band. 1te Heft. 1881.
Lisbon. Jornal de Sciencias Mathematicas, Physicas, e Naturaes. Nos. XXIV.–XXIX., 1879–80.
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II.—BOOKS PRESENTED OR OTHERWISE ADDED TO THE SOCIETY'S LIBRARY.

Names of Donors in Italics.

A. English, American, and Colonial Books and Pamphlets.

Highland and Ayr Society of Scotland. History of the Society, by Alexander Ramsay.
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Pilley, John J. Elements of Scientific Agriculture.
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Bunyard, George. Fruit Farming for Profit.
Prout, John. Profitable Clay Farming.
Karens, William, J.P. South Australia.
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Atwater, Professor W. O. (Connecticut). Report of Field Experiments with Fertilizers, 1880.
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Siemens, C. William, D.C.L., LL.D., F.R.S. On some Applications of Electric Energy to Horticulture and Agriculture; and a contribution to the history of Secondary Batteries.

Whitehead, Charles, F.L.S., F.G.S. Some Leading Features of the Agriculture of Kent.

————————. Fruit-Growing in Kent.

————————. Hops: from the Set to the Sky-Lights.

Hazell, Watson, and Viney. Procedings of the British National Veterinary Congress, 1881. Part I.

Royal Agricultural Society of England.

1882.

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Year when Elected.

Trustees.

1879 H.R.H. THE PRINCE OF WALES, K.G., *Marlborough House, Pall Mall*, S.W.
1855 ACLAND, Sir THOMAS DYKE, Bart., M.P., *Sprydoncote, Exeter, Devonshire.*
1857 BRIDPORT, General Viscount, *Cricket St. Thomas, Chard, Somersetshire.*
1850 CHESHAM, Lord, *Latimer, Chesham, Bucks.*
1863 KINGSCOTE, Colonel, M.P., *Kingscote, Wotton-under-Edge, Gloucestershire.*
1868 LICHFIELD, Earl of, *Shugborough, Staffordshire.*
1854 MACDONALD, Sir ARCHIBALD KEPPEL, Bt., *Woolmer Lodge, Liphook, Hants.*
1860 MARLBOROUGH, Duke of, K.G., *Blenheim Park, Oxford.*
1839 PORTMAN, Viscount, *Bryanston, Blandford, Dorset.*
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1858 RUTLAND, Duke of, K.G., *Belvoir Castle, Grantham, Leicestershire.*
1861 WELLS, WILLIAM, *Holmewood, Peterborough, Northamptonshire.*

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1873 BEDFORD, Duke of, K.G., *Woburn Abbey, Bedfordshire.*
1861 CATHCART, Earl, *Thornton-le-Street, Thirsk, Yorkshire.*
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1867 DEVONSHIRE, Duke of, K.G., *Holker Hall, Lancashire.*
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1848 GIBBS, Sir BRANDRETH, 13, *Pelham Crescent, South Kensington*, S.W.
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1859 VERNON, Lord, *Sudbury Hall, Derby.*
1855 WYNN, Sir WATKIN WILLIAMS, Bart., M.P., *Wynnstay, Ruabon, Denbighshire.*

Other Members of Council.

1881 *ALLENDER, G. MANDER, *Solna, Roehampton, Surrey.*
1858 AMOS, CHARLES EDWARDS, 5, *Cedars Road, Clapham Common, Surrey.*
1877 *ARKWRIGHT, J. H., *Hampton Court, Leominster, Herefordshire.*
1880 ASHWORTH, ALFRED, *Tabley Grange, Knutsford, Cheshire.*
1875 AYLMER, HUGH, *West Dereham, Stoke Ferry, Norfolk.*
1874 CHANDOS-POLE-GELL, H., *Hopton Hall, Wirksworth, Derbyshire.*
1860 *DRUCE, JOSEPH, *Eynsham, Oxford.*
1871 *EGERTON, Hon. WILBRAHAM, M.P., *Rostherne Manor, Knutsford, Cheshire.*
1873 EVANS, JOHN, *Uffington, Shrewsbury, Salop.*
1876 FEVERSHAM, Earl of, *Duncombe Park, Helmsley, Yorkshire.*
1879 *FOSTER, S. P., *Killhow, Carlisle, Cumberland.*
1875 *FRANKISH, WILLIAM, *Limber Magna, Ulceby, Lincolnshire.*
1881 *GILBEY, WALTER, *Elsenham Hall, Bishop's Stortford, Essex.*

* Those Members of the Council whose names are prefixed by an asterisk retire by rotation in July, but are eligible for re-election in May.

Year when Elected.	
1879	GORRINGE, HUGH, *Kingston-by-Sea, Shoreham, Sussex.*
1874	*HEMSLEY, JOHN, *Shelton, Newark, Notts.*
1876	HOWARD, CHARLES, *Biddenham, Bedford.*
1878	*HOWARD, JAMES, M.P., *Clapham Park, Bedfordshire.*
1871	JONES, J. BOWEN, *Ensdon House, Montford Bridge, R.S.O., Salop.*
1869	LEEDS, ROBERT, *Keswick Old Hall, Norwich.*
1872	*LEICESTER, Earl of, K.G., *Holkham Hall, Wells, Norfolk.*
1874	*LINDSAY, Colonel Sir R. LOYD, M.P., *Lockinge Park, Wantage, Berkshire.*
1881	LITTLE, H. J., *Coldham Hall, Wisbech, Cambs.*
1865	LOPES, Sir MASSEY, Bart., M.P., *Maristow, Roborough, Devon.*
1874	MARTIN, JOSEPH, *Highfield House, Littleport, Isle of Ely, Cambridgeshire.*
1880	*MORETON, Lord, M.P., *Tortworth Court, Falfield, R.S.O., Gloucestershire.*
1879	*NEVILLE, ROBERT, *Butleigh Court, Glastonbury, Somersetshire.*
1857	PAIN, THOMAS, *Audley's Wood, Basingstoke, Hants.*
1881	PARKER, Hon. CECIL T., *Eccleston, Chester.*
1861	*RANDELL, CHARLES, *Chadbury, Evesham, Worcestershire.*
1875	RANSOME, ROBERT CHARLES, *Ipswich, Suffolk.*
1867	RAVENSWORTH, Earl of, *Ravensworth Castle, Durham.*
1871	*RAWLENCE, JAMES, *Bulbridge, Wilton, Salisbury, Wilts.*
1869	RIDLEY, Sir M. WHITE, Bart., M.P., *Blagdon, Cramlington, Northumberland.*
1875	RUSSELL, ROBERT, *Horton Court Lodge, Dartford, Kent.*
1874	*SANDAY, GEORGE HENRY, *Wensley House, Bedale, Yorkshire.*
1878	*SHERATON, WILLIAM, *Broom House, Ellesmere, Salop.*
1856	*SHUTTLEWORTH, JOSEPH, *Hartsholme Hall, Lincoln.*
1874	SPENCER, Earl, K.G., *Althorp, Northampton.*
1882	*STAFFORD, Marquis of, M.P., *Trentham Hall, Stoke-upon-Trent, Staffs.*
1875	*STRATTON, RICHARD, *The Duffryn, Newport, Monmouthshire.*
1881	*THOROLD, Sir JOHN H., Bart., *Syston Park, Grantham, Lincolnshire.*
1874	*TURBERVILL, Lieut.-Col. PICTON, *Ewenny Priory, Bridgend, South Wales.*
1845	TURNER, GEORGE, *Great Bowley, Tiverton, Exeter, Devonshire.*
1871	TURNER, JABEZ, *Norman Cross, Huntingdonshire.*
1871	WAKEFIELD, WILLIAM H., *Sedgwick, Kendal, Westmoreland.*
1882	*WARREN, R. A., *Preston Place, Arundel, Sussex.*
1870	*WHITEHEAD, CHARLES, *Barming House, Maidstone, Kent.*
1865	WILSON, JACOB, *Woodhorn Manor, Morpeth, Northumberland.*
1878	*WISE, GEORGE, *Woodcote, Warwick.*

Secretary and Editor.

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Consulting Botanist—W. CARRUTHERS, F.R.S., F.L.S., *Central House, Central Hill, Norwood*, S.E.

Consulting Veterinary Surgeon—Professor JAMES BEART SIMONDS, *St. John's Villa, Ryde, Isle of Wight.*

Veterinary Inspectors—THE OFFICERS OF THE ROYAL VETERINARY COLLEGE.

Consulting Engineer—W. ANDERSON, 3, *Whitehall Place*, S.W.

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* Those Members of the Council whose names are prefixed by an asterisk retire by rotation in July, but are eligible for re-election in May.

STANDING COMMITTEES FOR 1882.

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KINGSCOTE, Colonel (Chairman).
BRIDPORT, General Viscount.
RIDLEY, Sir M. WHITE, Bt.
FRANKISH, W.
RANDELL, CHARLES.
SHUTTLEWORTH, J.

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RANDELL, C.
SHUTTLEWORTH, J.
WILSON, JACOB.

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CHANDOS-POLE-GELL, H.
DENT, J. D.
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HEMSLEY, J.
HOWARD, J.
JONES, J. BOWEN.
LITTLE, H. J.
LOYD-LINDSAY, Col. Sir R.
RANSOME, R. C.
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JONES, J. BOWEN.
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GIBBS, Sir BRANDRETH.
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CARRUTHERS, W.
FRANKISH, W.
GORRINGE, H.
JONES, J. BOWEN.
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PARKER, Hon. C. T.
TURBERVILL, Lieut.-Col.
VOELCKER, Dr.

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ALLENDER, G. M.
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BROWN, Professor.
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FOSTER, S. P.
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PARKER, Hon. C. T.
ROBERTSON, Professor.
SANDAY, G. H.
SANDERSON, Dr. J. BURDON.
SIMONDS, Professor.
STRATTON, R.
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WILSON, JACOB.

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GIBBS, Sir BRANDRETH.
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ASHWORTH, A.
AYLMER, H.
EVANS, JOHN.
FRANKISH, W.
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HEMSLEY, J.
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MARTIN, J.
PAIN, T.
RANDELL, C.
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MORETON, Lord.
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ANDERSON, W.
ASHWORTH, A.
FRANKISH, W.
GORRINGE, H.
HOWARD, C.
HOWARD, J.
JONES, J. BOWEN.
MARTIN, J.
NEVILLE, R.
PARKER, Hon. C. T.
RANSOME, R. C.
SANDAY, G. H.
SHERATON, W.
SHUTTLEWORTH, JOSEPH.
STRATTON, R.
TURBERVILL, Lieut.-Col.
TURNER, JABEZ.
WILSON, JACOB.
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General Reading Committee.

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MORETON. Lord.
VERNON, Lord.
RIDLEY, Sir M. W., Bt.
GIBBS, Sir BRANDRETH.
ASHWORTH, A.
AYLMER, H.
CHANDOS-POLE-GELL, H.
DAY, HENRY.
DENT, J. D.
DRUCE, J.
FOSTER, S. P.
FRANKISH, W.
GORRINGE, H.
HEMSLEY, J.
HOWARD, C.
JONES, J. BOWEN.
KINGSCOTE, Colonel.
LINDSAY, Col. Sir R. LOYD
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MESSER, J.
NEVILLE, R.
RANDELL, CHARLES.
SANDAY, G. H.
SHERATON, W.
SHUTTLEWORTH, J.
SUTTON, MARTIN J.
TURBERVILL, Lieut.-Col.
WAKEFIELD, W. H.
WHITEHEAD, CHARLES.
WILSON, JACOB.
WELLS, A. D.

Show-Yard Contracts Committee.

SHUTTLEWORTH, JOSEPH (Chairman).
GIBBS, Sir BRANDRETH.
AMOS, C. E.
CHANDOS-POLE-GELL, H.
FRANKISH, W.
HEMSLEY, J.
HOWARD, C.
RANDELL, CHARLES.
SANDAY, G. H.
STRATTON, R.
WILSON, JACOB.

Committee of Selection.

CATHCART, Earl (Chairman).
RIDLEY, Sir M. W.
FRANKISH, W.
RANDELL, C.
TURBERVILL, Lieut.-Col.
WAKEFIELD, W. H.
WILSON, JACOB.

And the Chairmen of the Standing Committees.

Education Committee.

MORETON, Lord (Chairman).
BEDFORD, Duke of.
DENT, J. D.
CARRUTHERS, W.
JONES, J. BOWEN.
KINGSCOTE, Colonel.
LITTLE, H. J.
PARKER, Hon. CECIL T.
TURBERVILL, Lieut.-Col.
VOELCKER, Dr.

Dairy Committee.

VERNON, Lord (Chairman).
BRIDPORT, Gen. Viscount.
CHESHAM, Lord.
MACDONALD, Sir A. K.
ALLENDER, G. M.
CHANDOS-POLE-GELL, H.
JONES, J. BOWEN.
KINGSCOTE, Colonel.
NEVILLE, B.
STRATTON, R.
VOELCKER, Dr.

Cattle Plague Committee.

THE WHOLE COUNCIL.

*** The PRESIDENT, TRUSTEES, and VICE-PRESIDENTS are Members *ex officio* of all Committees.

Royal Agricultural Society of England.

GENERAL MEETING,

12, Hanover Square, Thursday, December 8th, 1881.

REPORT OF THE COUNCIL.

The Council of the Royal Agricultural Society of England have to report that, during the year 1881, the number of Governors and Members has been increased by the election of 1 Governor and 461 Members, and diminished by the death of 5 Governors and 141 Members, the resignation of 236 Members, and the removal of 40 by order of the Council.

The Society now consists of:—

84 Life Governors,
69 Annual Governors,
2796 Life Members,
5154 Annual Members,
19 Honorary Members,

making a total of 8122, and showing an increase of 40 during the year.

Since the Annual Meeting of May the Council have been deprived of the services of four of their colleagues by the lamented death of Mr. W. T. Carrington and Mr. D. McIntosh, and the resignations of Sir W. E. Welby-Gregory, Bart., and Mr. E. Bowly. At the Annual Meeting an existing vacancy caused by the death of Mr. D. R. Davies was filled by the election of the Hon. Cecil T. Parker; and since then the Council have elected Mr. Walter Gilbey in the room of the late Mr. Odams, Sir John Thorold, Bart., in the place of Sir W. E. Welby-Gregory, and Mr. Herbert J. Little, of Coldham Hall, Wisbech, in the room of the late Mr. McIntosh. The

vacancies caused by the death of Mr. Carrington and the resignation of Mr. Bowly are still under the consideration of the Council.

The Council have also to announce with great regret the death of Mr. Henry Cantrell, who was for many years one of the Auditors of the Society. His place it is proposed to fill by the election of Mr. Charles Gay Roberts.

The half-yearly statement of accounts to the 30th June last has been examined and certified by the auditors and accountants of the Society, and has been published in the last number of the 'Journal,' for the information of the Members of the Society. The funded Capital of the Society has been increased by the investment of 3000*l.*, and now stands at 15,408*l.* 0*s.* 4*d.* New Three per Cents. The balance of the current account in the hands of the bankers on the 1st instant, was 675*l.* 7*s.*, and 4000*l.* remained on deposit, to cover the amount of unpaid accounts connected with the Derby Meeting, and to provide, if needful, materials and plant for the Reading Showyard.

The Council are glad to be able to announce that the experiment of constructing the Showyard by their own officers, and without the intervention of a contractor, which they commenced this year at Derby, has proved successful. A carefully prepared statement of accounts has been submitted to them, showing a saving to the Society under the present system of about 1300*l.*

The Derby Meeting was held during a period of uninterrupted sunshine; and this fortunate circumstance, coupled with the visit of His Royal Highness the Prince of Wales, and the accessibility of the Showyard, made the Meeting one of the most successful in the history of the Society. The Council are glad to announce that the large attendance of the public, and the more economical administration of the expenditure rendered necessary by recent losses, have together resulted in an addition to the Society's funds of about 4000*l.*

The offer of the Society's Gold Medal for the best Sheaf-binder, the binding material to be other than wire, produced an interesting competition, although the trials were much interrupted by unfavourable weather. The Awards of the Judges

have already been made known, and a complete account of the Trials will appear in the next number of the 'Journal.'

Although the competition for Prizes offered by the Derby Local Committee for the best-managed Farms in Derbyshire, and within a radius of 20 miles of Derby, was somewhat restricted,—especially in the Class for Small Dairy Farms,—it enabled the Judges to produce a very useful and interesting Report, which has been published in the last number of the 'Journal.'

The preparations for the Reading Meeting are now occupying the attention of the Council, and the Prizes for Live Stock have been finally settled. The Local Committee have liberally offered Prizes in additional Classes for Agricultural Horses, Hunters, Hackneys, Dairy Cattle, Hampshire and Oxford Down Sheep, as well as for Butter and Cheese. They have also offered Prizes for the best-managed Farms in the County of Berks, or within a radius of 20 miles from the Town Hall of Reading. Thirteen farms have been entered to compete in the Class of Large Farms, but only one in that for Small Farms; and the Council cannot avoid expressing their regret at the continued disinclination shown by small farmers to compete for these Prizes.

The following alteration has been made in the Rules of the Stock Prize Sheet:—

" *Protests.*—Any person or persons wishing to lodge a protest must obtain from the Secretary a printed form for the purpose, and deposit with him the sum of 5*l.*, and if on investigation the protest is not sustained to the satisfaction of the Stewards, the sum thus deposited shall, at the discretion of the Council, be forfeited to the funds of the Society. All protests must be delivered to the Stewards, at the Secretary's Office in the Show-yard, before Six o clock on the First evening of the Show-week; and no protest will be SUBSEQUENTLY received, unless a satisfactory reason be assigned for the delay. The Stewards will be instructed to endeavour, if possible, to decide all protests before the conclusion of the Meeting."

The Council have decided to offer Prizes at the Reading Meeting for Fruits and Vegetables grown under ordinary field culture by occupiers who have at least one-half of their land

under ordinary farming cultivation. They have also established two Classes for Market Gardeners.

The Council have decided to offer in connection with the Reading Meeting the Gold Medal of the Society for an efficient and economical apparatus for excavating field drains, and for Cream Separators in two classes—in one class the machines to be driven by mechanical power, and in the other by manual or horse-power. They have also offered special Prizes for an efficient portable Straw-compressing and Binding Machine, to be worked in conjunction with a threshing-machine; and for the best Milking Machine, to be tested during six consecutive months of the spring and summer of 1883.

The Council have thankfully accepted the offer of Mr. Martin J. Sutton of a Prize of one hundred guineas for an efficient and economical method of drying hay or corn crops artificially, either before or after being stacked, and they have arranged that the exhibition of the apparatus at the Reading Show shall not be an absolute requirement, but that appliances for the purpose already fixed, or which may be fixed, at farm homesteads, and which are not portable, shall be eligible to compete.

With a view to obtain reliable information of a practical character respecting the treatment of animals affected with Foot-and-mouth disease, the Council have arranged with the authorities of the Royal Veterinary College to carry out a series of observations and experiments. It is hoped to ascertain the possibility by treatment to mitigate the severity of the disease as well as to lessen the danger of infection, and the susceptibility of animals exposed to the risk of taking the disease.

The Council have decided that the Reading Meeting shall commence on Monday, July 10th, and close on the following Friday evening.

The district assigned for the Country Meeting of 1883 comprises the whole of the County of York.

In view of the great and increasing importance of Dairying as a branch of English Agriculture, the Council have appointed a Standing Dairy Committee, so that all questions relating to this subject may receive the consideration of a department specially responsible to the Council for its supervision.

The Council being strongly of opinion that all manures and feeding stuffs should be bought of a guaranteed composition, and that a sample of the bulk should be afterwards sent for analysis, have reduced the fees for analysis charged to Members of the Society in one important respect. They regret, however, to report that the analytical work of the Laboratory shows a falling off as compared with last year, the number of samples sent having been 1058 this year as against 1201 in 1880.

Thirty-one candidates were entered for examination for the Society's Junior Scholarship from the following schools :—Albert Institution, Glasnevin, 3; Aspatria Agricultural School, 3; Bedford County School, 2; Devon County School, 2; Sandbach Grammar School, 1; Surrey County School, 20. According to the Reports already received from the Examiners the following five candidates have been successful in the order named :—

Surrey County School	P. H. PURCHASE.
Bedford County School	J. D. TWINBERROW.
" " "	H. L. JENKINS.
Surrey County School	CHARLES BROOKS.
" " "	A. G. ATKINS.

By order of the Council,

H. M. JENKINS,
Secretary.

Royal Agricultural Society of England.

1882.

DISTRIBUTION OF MEMBERS OF THE SOCIETY AND OF MEMBERS OF COUNCIL.

Districts.	Counties.	Number of Members.	Number in Council.	Members of Council.
A.	Bedfordshire ..	122 ..	3	Duke of Bedford, K.G., V.P.; C. Howard; James Howard.
	Buckinghamshire	103 ..	1	Lord Chesham, T.
	Cambridgeshire ..	95 ..	2	J. Martin; H. J. Little.
	Essex	266 ..	1	W. Gilbey.
	Hertfordshire ..	150 ..	1	J. B. Lawes, V.P.
	Huntingdonshire ..	46 ..	2	Jabez Turner; W. Wells, T.
	Middlesex	417 ..	2	Sir Brandreth Gibbs, V.P.; G. M. Allender.
	Norfolk	315 ..	4	H.R.H. the Prince of Wales, K.G., T.; Earl of Leicester; Hugh Aylmer; Robert Leeds.
	Oxfordshire ..	142 ..	2	Duke of Marlborough, T.; J. Druce.
	Suffolk	156 ..	2	Sir E. C. Kerrison, V.P., R. C. Ransome.
		—— 1812	— 20	
B.	Cumberland	207 ..	1	S. P. Foster.
	Durham	152 ..	1	Earl of Ravensworth.
	Northumberland ..	158 ..	2	Sir M. White Ridley; Jacob Wilson.
	Westmoreland ..	68 ..	1	W. H. Wakefield.
		—— 585	— 5	
C.	Derbyshire	242 ..	2	Lord Vernon, V.P.; H. Chandos Pole-Gell.
	Leicestershire ..	103 ..	1	Duke of Rutland, T.
	Lincolnshire	203 ..	3	W. Frankish; J. Shuttleworth; Sir J. H. Thorold.
	Northamptonshire	128 ..	1	Earl Spencer.
	Nottinghamshire ..	175 ..	1	J. Hemsley.
	Rutland	16 ..		
		—— 867	— 8	

DISTRIBUTION OF MEMBERS OF THE SOCIETY—*continued.*

Districts.	Counties.	Number of Members.	Number in Council.	Members of Council.
D.	Berkshire	148 ..	1	Sir R. Loyd Lindsay.
	Cornwall	53 ..		
	Devonshire	112 ..	3	Sir T. D. Acland, T.; Sir M. Lopes; G. Turner.
	Dorsetshire	68 ..	1	Viscount Portman, T.
	Hampshire	151 ..	3	Viscount Eversley, V.P.; Sir A. K. Macdonald, T.; T. Pain.
	Kent	383 ..	2	R. Russell; C. Whitehead.
	Somersetshire ..	158 ..	2	Visct. Bridport, T.; R. Neville.
	Surrey	176 ..	1	C. E. Amos.
	Sussex	169 ..	4	Earl of Chichester, V.P.; Duke of Richmond and Gordon, V.P.; H. Gorringe; R. A. Warren.
	Wiltshire	107 ..	1	J. Rawlence.
		——1525	— 18	
E.	Yorkshire	386 ..	4	Earl Cathcart, V.P.; Earl of Feversham; J. D. Dent, T.; G. H. Sanday.
F.	Gloucestershire ..	223 ..	2	Lord Moreton; Col. Kingscote, T.
	Herefordshire ..	96 ..	1	J. H. Arkwright.
	Monmouthshire ..	46 ..	1	R. Stratton.
	Shropshire	380 ..	3	John Evans; J. Bowen Jones; W. Sheraton.
	Staffordshire ..	290 ..	2	Earl of Lichfield, T.; Marquis of Stafford.
	Warwickshire ..	208 ..	1	George Wise.
	Worcestershire ..	168 ..	1	C. Randell.
	South Wales ..	179 ..	1	Lt.-Col. Picton Turbervill.
		——1590	— 12	
G.	Cheshire	212 ..	3	Hon. W. Egerton; A. Ashworth; Hon. Cecil T. Parker.
	Lancashire	303 ..	2	Duke of Devonshire, V.P.; Earl of Lathom, V.P.
	North Wales ..	198 ..	2	Earl of Powis, T.; Sir W. W. Wynn, V.P.
		—— 713	— 7	
Scotland		116		
Ireland		106		
Channel Islands		11		
Foreign Countries		95		
Members without addresses ..		68		
		—— 396		

ROYAL AGRICULTURAL

Dr. — HALF-YEARLY CASH ACCOUNT

	£ s. d.	£ s. d.	£ s. d.
To Balance in hand, 1st July, 1881:—			
Bankers	2,155 2 3		
Secretary	66 1 11		
		2,221 4 2	
At Deposit		2,000 0 0	
			4,221 4 2
To Income:—			
Dividends on Stock		226 6 1	
Interest on Deposit		50 8 9	
Subscriptions:—			
Governors' Annual	20 0 0		
Members' Life-Compositions	530 0 0		
Members' Annual	957 2 0		
		1,507 2 0	
Establishment:—			
Rent		100 0 0	
Journal:—			
Sales	78 11 2		
Advertisements	60 15 3		
Sale of Pamphlets	19 2 0		
		158 8 5	
Chemical:—			
Laboratory Fees		151 0 0	
Veterinary:—			
Balance of Payments to Brown Institution not expended	224 4 1		
Professional Fees	9 6 6		
		233 10 7	
Farm Inspection:—			
Prizes given by Derby Local Committee	313 15 0		
Entry Fees for 1882	21 0 0		
		334 15 0	
Sundries		8 0 0	
Carlisle Meeting		124 5 6	
Total Income		.. .. ..	2,893 16 4
To Derby Meeting		.. .. ..	17,147 15 1
			£24,262 15 7

BALANCE-SHEET,

LIABILITIES.	£ s. d.	£ s. d.	£ s. d.
To Capital:—			
Surplus, 30th June, 1881		19,683 9 9	
Less surplus of Expenditure over Income during the Half-year, viz.:—			
Expenditure	3,909 8 8		
Income	2,893 16 4		
		1,015 12 4	
		18,667 17 5	
Deduct half-year's interest and depreciation on Country Meeting Plant		300 9 2	
			18,367 8 3
To Derby Meeting:—			
Excess of Receipts over Expenditure		.. .. ..	4,929 19 9
			£23,297 8 0

QUILTER, BALL, CROSBIE, GLEGG, & WELTON, *Accountants.*

SOCIETY OF ENGLAND.

FROM 1ST JULY TO 31ST DECEMBER, 1881. Cr.

	£ s. d.	£ s. d.	£ s. d.
By Expenditure:—			
Establishment:—			
Salaries, Wages, &c.	777 10 0		
House:—Rent, Taxes, Repairs, &c.	466 7 7		
Office:—Printing, Postage, Stationery, &c.	245 13 0		
		1,489 10 7	
Journal:—			
Printing and Stitching	627 9 3		
Postage and Delivery	140 0 0		
Literary Contributions	183 17 0		
Reprint of Vol. 12, Part I.	103 4 0		
Printing Pamphlets	44 16 3		
		1,099 6 6	
Chemical:—			
Salaries	382 10 0		
Apparatus	13 13 9		
Repairs	44 10 1		
		440 13 10	
Veterinary:—			
Professional Fees		2 6 0	
Botanical:—			
Consulting Botanist's Salary		50 0 0	
Education:—			
Fees to Examiners	15 15 0		
Printing and Advertising	33 4 0		
Scholarships	160 0 0		
		208 19 0	
Farm Inspection:—			
Prizes	313 15 0		
Judges	198 6 3		
		512 1 3	
Subscriptions (paid in error) returned		1 11 6	
Carlisle Meeting		105 0 0	
Total Expenditure		.. .. ..	3,909 8 8
By Stock:—			
Purchase of £5992 14*s.* 9*d.* New 3 per Cents.		.. .. ..	6,000 0 0
By Derby Meeting		13,136 2 8	
By Reading Meeting		629 6 1	
			13,765 8 9
By Balance in hand, 31st Dec.:—			
Bankers		562 9 0	
Secretary		25 9 2	
			587 18 2
			£24,262 15 7

31ST DECEMBER, 1881.

ASSETS.	£ s. d.	£ s. d.
By Cash in hand	587 18 2	
By New 3 per Cent. Stock 18,423*l.* 1*s.* 9*d.* cost*	17,677 17 1	
By Books and Furniture in Society's House	1,451 17 6	
By Country Meeting Plant	2,950 9 2	
		22,668 1 11
At Debit of Reading Meeting	.. .. ..	629 6 1
		£23,297 8 0

* *Value at* $99\frac{7}{8}$ = £18,400 1*s.* 2*d.*

Mem.—The above Assets are exclusive of the amount recoverable in respect of arrears of Subscription to 31st Dec., 1881, which at that date amounted to 1654*l.*

Examined, audited, and found correct, this 6th day of March, 1882.

FRANCIS SHERBORN,
A. H. JOHNSON,
C. GAY ROBERTS,
} *Auditors on behalf of the Society.*

ROYAL AGRICULTURAL

DR. YEARLY CASH ACCOUNT

	£ s. d.	£ s. d.	£ s. d.
To Balance in hand, 1st Jan. 1881:—			
Bankers	. .	301 19 2	
Secretary	. .	44 3 11	
			346 3 1
To Income:—			
Dividends on Stock	. .	408 2 0	
Interest on Deposit Account	. .	50 8 9	
Subscriptions:—			
Governors' Annual	300 0 0		
Members' Life-Compositions	1,147 0 0		
Members' Annual	4,648 18 6		
		6,095 18 6	
Establishment:—			
Rent	. .	300 0 0	
Journal:—			
Sales	161 19 9		
Advertisements	110 11 8		
Sale of Pamphlets	19 2 0		
		291 13 5	
Chemical:—			
Laboratory Fees	. .	308 11 3	
Veterinary:—			
Balance of payments to the Brown Institution not expended	224 4 1		
Professional Fees	9 17 0		
		234 1 1	
Farm-Inspection:—			
Prizes given by the Derby Local Committee	313 15 0		
Entry Fees for 1882	21 0 0		
		334 15 0	
Sundries	. .	8 0 0	
Carlisle Meeting	. .	194 4 0	
Total Income	. .		8,225 14 0
To Derby Meeting	. .	. .	24,111 4 0
			£32,683 1 [illegible]

OCIETY OF ENGLAND.

ROM 1ST JANUARY TO 31ST DECEMBER, 1881. CR.

	£ s. d.	£ s. d.	£ s. d.
Expenditure:—			
Establishment:—			
Salaries, Wages, &c.	1,548 0 0		
House: Rent, Taxes, &c.	814 15 6		
Office: Printing, Postage, Stationery, &c.	535 12 11		
		2,898 8 5	
Journal:—			
Printing and Stitching	1,122 1 5		
Postage and Delivery	340 0 0		
Advertising	8 19 3		
Literary Contributions	298 8 0		
Lithographing	5 10 0		
Reprint of Vol. XII., Part I.	103 4 0		
Printing Pamphlets	44 16 3		
		1,922 18 11	
Chemical:—			
Salaries	835 0 0		
Fittings for Laboratory	10 2 2		
Apparatus	29 15 10		
Repairs	44 10 1		
Petty Payments	10 0 0		
		929 8 1	
Veterinary:—			
Prizes and Medals	47 12 0		
Fees to Examiners	21 16 9		
Professional Fees	11 2 6		
		80 11 3	
Botanical:—			
Consulting Botanist's Salary	. .	100 0 0	
Education:—			
Fees to Examiners	68 5 0		
Printing and Advertising	62 1 4		
Scholarships	160 0 0		
Prizes	50 0 0		
		340 6 4	
Farm Inspection:—			
Prizes	313 15 0		
Judges	198 6 3		
Advertising	55 12 2		
		567 13 5	
Sundries:—			
Medals for Corn Competition	3 12 0		
Expenses of ditto	5 3 0		
Collecting evidence for the Railway Commission	66 19 8		
		75 14 8	
Subscriptions (paid in error) returned	. .	3 11 6	
Carlisle Meeting	. .	231 11 0	
London Meeting	. .	35 13 0	
Total Expenditure	. .	. .	7,235 16 7
Stock:—			
Purchase of £5992 14*s.* 9*d.* New 3 Per Cents.	. .	. .	6,000 0 0
Derby Meeting	. .	18,230 0 3	
Reading Meeting	. .	629 6 1	
			18,859 6 4
Balance in hand, 31st Dec.:—			
Bankers	. .	562 9 0	
Secretary	. .	25 9 2	
			587 18 2
			£32,683 1 1

RECEIPTS.

	£	s.
Subscription from Derby	2,000	0
Admissions to Show Yard by Payment	9,372	15
Admissions by Season Tickets	327	2
Admissions to Stand at Horse Ring	396	11
Admissions to Dairy	42	4
Sale of Catalogues	686	10
Entries in Implement Catalogue	400	0
Advertisements in Stock Catalogues	269	1
Implement Exhibitors' Payment for Shedding	4,080	17
Non-Members' Fees for entry of Implements	202	0
Fees for entry of Live-Stock, &c.	434	5
Fees for Horse Boxes and Stalls	183	10
Premiums for Supply of Refreshments	540	0
Premium for Cloak Rooms, Lavatories, &c.	60	0
Sale of Fodder and Manure	96	18
Fines for Non-Exhibition of Live-Stock	85	0
Fines for Non-Exhibition of Implements	100	0
Reference Number Fines	4	17
Sales of Butter	16	10
	£19,303	2

ACCOUNT, DERBY, 1881.

EXPENDITURE.

	£ s. d.	£ s. d.
HOW YARD WORKS:—		
By Timber and Joinery	4,005 1 3	
,, Ironmongery, 60*l.* 4*s.* 11*d.*; Hurdles, 116*l.* 13*s.* 4*d.*	176 18 3	
,, Paints, Oils, Glass, &c.	194 7 1	
,, Canvas, 1350*l.* 17*s.* 3*d.*; Felt, Baize, &c., 191*l.* 14*s.* 11*d.*	1,542 12 2	
,, Floor, &c., for Dairy	57 13 7	
,, Insurance	15 15 0	
,, Railway Charges, &c.	360 6 1	
,, Horse Hire	107 19 0	
,, Coals, 8*l.* 13*s.* 2*d.*; Cisterns, 10*l.*	18 13 2	
,, Furniture, 9*l.* 9*s.*; Postage and Stationery, 46*l.* 9*s.* 3*d.*	55 18 3	
,, Restoring Carriage Drive, 24*l.* 18*s.*; Sundries, 25*l.* 8*s.* 8*d.*	50 6 8	
,, Superintendent of Works—Salary and Expenses	702 17 11	
,, Wages	1,425 17 8	
,, Depreciation of Plant	503 17 8	
		9,218 3 9
Per Contra:—		
By Auction Sales, 2,845*l.* 8*s.* 9*d.*; Private Sale 34*l.* 8*s.*	2,879 16 9	
,, Exhibitors and Purveyors	989 11 4	
		3,869 8 1
		5,348 15 8
ıdges.—Implements, 88*l.*; Stock, &c., 283*l.* 14*s.* 8*d.*		371 14 8
nsulting Engineers and Assistants		178 13 1
ıspectors.—Veterinary, 79*l.* 6*s.*; Shearing, 31*l.* 14*s.* 4*d.*		111 0 4
olice.—Metropolitan, 452*l.* 19*s.* 6*d.*; Local, at Trials, 13*l.* 16*s.* 5*d.*		466 15 11
erks and Assistants.—Bankers, 20*l.*; Secretary and Stewards, 95*l.* 9*s.* 4*d.*		115 9 4
oremen and Assistant-Foremen		122 4 0
ardmen, Grooms, Labourers, &c., 187*l.* 10*s.* 11*d.*; Fieldmen, 55*l.* 14*s.*		243 4 11
ıdex Clerk and Money Takers, 54*l.* 17*s.* 6*d.*; Money Changers, Doorkeepers, 79*l.* 14*s.* 1*d.*		134 11 7
ewards' Expenses, 200*l.* 16*s.* 1*d.*; Assistant-Stewards, 111*l.* 5*s.*		312 1 1
odgings for Stewards, Judges, and other Officials		207 11 3
efreshments and Allowances		200 16 11
ıtalogues.—Implements, 330*l.* 9*s.*; Stock, 256*l.* 6*s.*; Awards, 14*l.* 5*s.*; Plan of Yard, 20*l.*; Packing, 4*l.* 10*s.*; Commission on Selling, 47*l.* 8*s.* 6*d.*		672 18 6
ay, 195*l.*; Straw, 340*l.*; Green Food, 288*l.*		823 0 0
rinting, 638*l.* 5*s.* 2*d.*; Advertising and Bill Posting, 748*l.* 6*s.*		1,386 11 2
ostage, Telegrams, Stationery, Carriage, &c.		146 12 9
epairs, Insurance, and Carriage of Testing Machinery		95 17 4
Iorse and Carriage Hire		187 3 11
ourneys previous to Show, 16*l.* 5*s.*; Expenses of Official Staff, 26*l.* 0*s.* 10*d.*		42 5 10
and for Trials and Damage to Crops		251 16 0
ee Shed, 20*l.*; Fire Brigade, 24*l.* 14*s.*; Hire of Chairs, 25*l.* 2*s.* 6*d.*		69 16 6
Iilk, 49*l.* 0*s.* 10*d.*; Ice, Salt, and Rennet, 14*l.* 14*s.*; Jars and Bottles, 19*s.* 3*d.*; Cheesemaker, Demonstrator, &c., at Dairy, 39*l.* 16*s.* 3*d.*; Hire of Engine for ditto, 13*l.* 18*s.* 10*d.*		118 9 2
evelling Yard		100 0 0
ntertaining Prince of Wales, 129*l.* 19*s.* 7*d.*; Furniture, &c., 115*l.* 1*s.*		245 0 7
ompensation to Refreshment Contractor, 20*l.*; Telegraph, 2*l.* 10*s.* 9*d.*		22 10 9
urveyor at Trials, 11*l.* 11*s.*; Mowing, &c., at Trials, 4*l.* 16*s.*		16 7 0
orn, Veterinary Medicines, Hire of Harmonium, and Petty Payments		18 15 0
osettes, 18*l.* 9*s.* 11*d.*; Medals, 26*l.* 3*s.*		44 12 11
tock Prizes*		2,720 0 0
		£14,774 16 2
By Balance		4,528 6 0
		£19,303 2 2

* Exclusive of 595*l.* given by the Derby Local Committee, 60*l.* by the Short-horn Society, and 80*l.* by the Shropshire Breeders.

MEMORANDA.

ADDRESS OF LETTERS.—The Society's office being situated in the postal district designated by the letter W. Members, in their correspondence with the Secretary, are requested to subjoin that letter to the usual address.

GENERAL MEETING in London, May 22nd, 1882, at 12 o'clock.

ANNUAL EXCURSION to Woburn, Tuesday, May 23rd. For particulars apply to the Secretary previous to May 15th, after which no tickets will be issued.

MEETING at Reading, July 10th, 1882, and four following days.

GENERAL MEETING in London, December, 1882.

MONTHLY COUNCIL (for transaction of business), at 12 o'clock on the first Wednesday in every month, excepting January, September, and October: open only to Members of Council and Governors of the Society.

ADJOURNMENTS.—The Council adjourn over Passion and Easter weeks, when those weeks do not include the first Wednesday of the month; from the first Wednesday in August to the first Wednesday in November; and from the first Wednesday in December to the first Wednesday in February.

OFFICE HOURS.—10 to 4. On Saturdays, 10 to 2.

DISEASES of Cattle, Sheep, and Pigs.—Members have the privilege of applying to the Veterinary Committee of the Society, and of sending animals to the Royal Veterinary College, Camden Town, N.W.—(A statement of these privileges will be found on page xix in this Appendix.)

CHEMICAL ANALYSIS.—The privileges of Chemical Analysis enjoyed by Members of the Society will be found stated in this Appendix (page xx).

BOTANICAL PRIVILEGES.—The Botanical and Entomological Privileges enjoyed by Members of the Society will be found stated in this Appendix (page xxiii).

SUBSCRIPTIONS.—1. Annual.—The subscription of a Governor is £5, and that of a Member £1, due in advance on the 1st of January of each year, and becoming in arrear if unpaid by the 1st of June. 2. For Life.—Governors may compound for their subscription for future years by paying at once the sum of £50, and Members by paying £10. Governors and Members who have paid their annual subscription for 20 years or upwards, and whose subscriptions are not in arrear, may compound for future annual subscriptions, that of the current year inclusive, by a single payment of £25 for a Governor, and £5 for a Member.

PAYMENTS.—Subscriptions may be paid to the Secretary, in the most direct and satisfactory manner, either at the Office of the Society, No. 12, Hanover Square, London, W., or by means of post-office orders, to be obtained at any of the principal post-offices throughout the kingdom, and made payable to him at the Vere Street Office, London, W.; but any cheque on a banker's or any other house of business in London will be equally available, if made payable on demand. In obtaining post-office orders care should be taken to give the postmaster the correct initials and surname of the Secretary of the Society (H. M. Jenkins), otherwise the payment will be refused to him at the post-office on which such order has been obtained; and when remitting the money-orders it should be stated by whom, and on whose account, they are sent. Cheques should be made payable as drafts on demand (not as bills only payable after sight or a certain number of days after date), and should be drawn on a London (not on a local country) banker. When payment is made to the London and Westminster Bank, St. James's Square Branch, as the bankers of the Society, it will be desirable that the Secretary should be advised by letter of such payment, in order that the entry in the banker's book may be at once identified, and the amount posted to the credit of the proper party. No coin can be remitted by post, unless the letter be registered.

NEW MEMBERS.—Every candidate for admission into the Society must be proposed by a Member; the proposer to specify in writing the full name, usual place of residence, and post-town, of the candidate, either at a Council meeting, or by letter addressed to the Secretary. Forms of Proposal may be obtained on application to the Secretary.

*** Members may obtain on application to the Secretary copies of an Abstract of the Charter and Bye-laws, of a Statement of the General Objects, &c., of the Society, of Chemical, Botanical, and Veterinary Privileges, and of other printed papers connected with special departments of the Society's business.

Members' Veterinary Privileges.

I.—Visits of the Veterinary Inspector.

1. Any Member of the Society who may desire professional attendance and special advice in cases of disease among his cattle, sheep, or pigs, should apply to the Secretary of the Society, or to the Principal of the Royal Veterinary College, and Consulting Veterinary Surgeon, Camden Town, London, N.W.

2. The remuneration of the Consulting Veterinary Surgeon or Inspector will be 2*l.* 2*s.* each day as a professional fee, and the charge for personal expenses, *when such have been incurred*, will in no case exceed one guinea per diem. He will also be allowed to charge the cost of travelling to and from the locality where his services may have been required. These charges may, however, in cases of serious or extensive outbreaks of contagious disease, be reduced or remitted altogether, so far as the Members of the Society are concerned, at the discretion of the Council, on such step being recommended to them by the Veterinary Committee.

3. The Inspector, on his return from visiting the diseased stock, will report to the Member, and, through the Principal of the Royal Veterinary College, to the Committee, in writing, the results of his observations and proceedings, which Report will be laid before the Council.

4. When contingencies arise to prevent a personal discharge of the duties, the Consulting Veterinary Surgeon may, subject to the approval of the Committee, name some competent professional person to act in his stead, who shall receive the same rates of remuneration.

II.—Consultations without Visit.

Personal consultation with Veterinary Inspector	10*s.* 6*d.*
Consultation by letter	10*s.* 6*d.*
Post-mortem examination, and report thereon ..	21*s.*

A return of the number of applications from Members of the Society during each half-year is required from the Veterinary Inspector.

III.—Admission of Diseased Animals to the Royal Veterinary College, Camden Town, N.W.; Investigations and Reports.

1. All Members of the Society have the privilege of sending cattle, sheep, and pigs to the Infirmary of the Royal Veterinary College, on the following terms; viz., by paying for the keep and treatment of cattle 10*s.* 6*d.* per week each animal, and for sheep and pigs, 3*s.* 6*d.* per week.

2. A detailed Report of the cases of cattle, sheep, and pigs treated in the Infirmary of the College, or on Farms in the occupation of Members of the Society, will be furnished to the Council quarterly; and also special reports from time to time on any matter of unusual interest which may come under the notice of the Officers of the College.

By Order of the Council,

H. M. JENKINS, *Secretary.*

Members' Privileges of Chemical Analysis.

(Applicable only to the case of Persons who are not commercially engaged in the manufacture or sale of any substance sent for Analysis.)

The Council have fixed the following rates of Charges for Analysis to be made by the Consulting Chemist for the *bonâ-fide* and sole use of Members of the Society; who, to avoid all unnecessary correspondence, are particularly requested, when applying to him, to mention the kind of analysis they require, and to quote its number in the subjoined schedule. The charge for analysis, together with the carriage of the specimens (if any), must be paid to him by Members at the time of their application:

No.

1.—An opinion of the genuineness of bone-dust or oil-cake (each sample) 2*s.* 6*d.*

2.—An estimate of the value (relatively to the average samples in the market) of sulphate and muriate of ammonia and of the nitrates of potash and soda .. .. 5*s.*

3.—An analysis of guano; showing the proportion of moisture, organic matter, sand, phosphate of lime, alkaline salts and ammonia, and an estimate of its value, provided the selling price of the article to be analysed be sent with it .. .. 10*s.*

4.—An analysis of mineral superphosphate of lime for soluble phosphates only, and an estimate of its value, provided the selling price of the article to be analysed be sent with it .. .. 5*s.*

5.—An analysis of superphosphate of lime, showing the proportions of moisture, organic matter, sand, soluble and insoluble phosphates, sulphate of lime, and ammonia, and an estimate of its value, provided the selling price of the article to be analysed be sent with it .. 10*s.*

6.—An analysis, showing the value of bone-dust or any other ordinary artificial manure, provided the selling price of the manure to be analysed be sent with it .. .. 10*s.*

7.—An analysis of limestone, showing the proportion of lime .. .. 7*s.* 6*d.*

8.—An analysis of limestone, showing the proportion of magnesia, 10*s.*; the proportion of lime and magnesia .. .. 10*s.*

9.—An analysis of limestone or marls, showing the proportion of carbonate, phosphate, and sulphate of lime and magnesia, with sand and clay 10*s.*

10.—Partial analysis of a soil, including determinations of clay, sand, organic matter, and carbonate of lime .. .. 10*s.*

11.—Complete analysis of a soil £3

12.—An analysis of oil-cake or other substance used for feeding purposes, showing the proportion of moisture, oil, mineral matter, albuminous matter, and woody fibre, as well as of starch, gum, and sugar in the aggregate; and an opinion of its feeding and fattening or milk-producing properties .. .. 10*s.*

13.—Analysis of any vegetable product .. .. 10*s.*

14.—Analysis of animal products, refuse substances used for manures, &c. from 10*s.* to £1

15.—Determination of the "hardness" of a sample of water before and after boiling .. .. 5*s.*

16.—Analysis of water of land-drainage, and of water used for irrigation £1

17.—Analysis of water used for domestic purposes .. .. £1 10*s.*

18.—Determination of nitric acid in a sample of water .. .. .. 10*s.*

19.—Examination of Viscera for Metallic poison .. .. £2 2*s.*

20.—Examination of Viscera complete, for metals and alkaloids .. .. £5 5*s.*

21.—Personal consultation with the Consulting Chemist. (The usual hours of attendance for the Director, Monday excepted, will be from 11 to 2, but to prevent disappointment, it is suggested that Members desiring to hold a consultation with the Director should write to make an appointment) .. .. 5*s.*

22.—Consultation by letter .. .. 5*s.*

23.—Consultation necessitating the writing of three or more letters .. 10*s.*

The Laboratory of the Society is at 12, Hanover Square, London, W., to which address the Consulting Chemist, Dr. Augustus Voelcker, F.R.S., requests that all letters and parcels (postage and carriage paid) from Members of the Society, who are entitled to avail themselves of the foregoing Privileges, should be directed.

GUIDE TO THE PURCHASE OF ARTIFICIAL MANURES AND FEEDING STUFFS.

Feeding Cakes.

1. *Linseed-cake* should be purchased as "Pure," and the insertion of this word on the invoice should be insisted upon. The use of such words as "Best," "Genuine," &c., should be objected to by the purchaser.

2. *Rape-cake for feeding purposes* should be guaranteed "Pure" and purchased by sample.

3. *Decorticated Cotton-cake* should be guaranteed "Pure," and purchased by sample.

4. *Undecorticated Cotton-cake* should be guaranteed "Pure," and purchased by sample.

N.B.—All feeding cakes should be purchased in good condition, and the guarantee of the vendor should be immediately checked by a fair sample (taken out of the middle of the cake) being at once sent for examination to a competent analytical chemist. The remainder of the cake from which the sample sent for examination had been taken should be sealed up in the presence of a witness, and retained by the purchaser for reference in case of dispute.

Artificial Manures.

1. *Raw or Green Bones or Bone-dust* should be purchased as "Pure" Raw Bones guaranteed to contain not less than 45 per cent. of tribasic phosphate of lime, and to yield not less than 4 per cent. of ammonia.

2. *Boiled Bones* should be purchased as "Pure" Boiled Bones guaranteed to contain not less than 48 per cent. of tribasic phosphate of lime, and to yield not less than 1¾ per cent. of ammonia.

3. *Dissolved Bones* are made of various qualities, and are sold at various prices per ton; therefore the quality should be guaranteed, under the heads of *soluble* phosphate of lime, *insoluble* phosphate of lime, and nitrogen or its equivalent as ammonia. The purchaser should also stipulate for an allowance for each unit per cent. which the dissolved bones should be found on analysis to contain less than the guaranteed percentages of the three substances already mentioned.

4. *Mineral Superphosphates* should be guaranteed to be delivered in a sufficiently dry and powdery condition, and to contain a certain percentage of *soluble* phosphate of lime, at a certain price per unit per cent., no value to be attached to *insoluble* phosphates.

5. *Compound Artificial Manures* should be purchased in the same manner and with the same guarantees as Dissolved Bones.

6. *Nitrate of Soda* should be guaranteed by the vendor to contain from 94 to 95 per cent. of pure nitrate.

7. *Sulphate of Ammonia* should be guaranteed by the vendor to contain not less than 23 per cent. of ammonia.

8. *Peruvian Guano* should be sold under that name, and guaranteed to be in a dry and friable condition, and to contain a certain percentage of ammonia.

N.B.—Artificial manures should be guaranteed to be delivered in a sufficiently dry and powdery condition to admit of distribution by the drill. A sample for analysis should be taken, not later than three days after delivery, by emptying several bags, mixing the contents together, and filling two tins holding about half a pound each, in the presence of a witness. Both the tins should be sealed, one kept by the purchaser for reference in case of dispute, and the other forwarded to a competent analytical chemist for examination.

INSTRUCTIONS FOR SELECTING AND SENDING SAMPLES FOR ANALYSIS.

ARTIFICIAL MANURES.—Take a large handful of the manure from three or four bags, mix the whole on a large sheet of paper, breaking down with the hand any lumps present, and fold up in tinfoil, or in oil-silk, about 3 oz. of the well-mixed sample, and send it to 11, SALISBURY SQUARE, FLEET STREET, E.C., by post: or place the mixed manure in a small wooden or tin box, which may be tied by string, but must not be sealed, and send it by post. If the manure be very wet and lumpy, a larger boxful, weighing from 10 to 12 oz., should be sent either by post or railway.

Samples not exceeding 4 oz. in weight may be sent by post, by attaching two penny postage stamps to the parcel.

Samples not exceeding 8 oz., for three postage stamps.

Samples not exceeding 12 oz., for four postage stamps.

The parcels should be addressed: DR. AUGUSTUS VOELCKER, 12, HANOVER SQUARE, LONDON, W., and the address of the sender or the number or mark of the article be stated on parcels.

The samples may be sent in covers, or in boxes, bags of linen or other materials. No parcel sent by post must exceed 12 oz. in weight, 1 foot 6 inches in length, 9 inches in width, and 6 inches in depth.

SOILS.—Have a wooden box made 6 inches long and wide, and from 9 to 12 inches deep, according to the depth of soil and subsoil of the field. Mark out in the field a space of about 12 inches square; dig round in a slanting direction a trench, so as to leave undisturbed a block of soil with its subsoil from 9 to 12 inches deep; trim this block or plan of the field to make it fit into the wooden box, invert the open box over it, press down firmly, then pass a spade under the box and lift it up, gently turn over the box, nail on the lid and send it by goods or parcel to the laboratory. The soil will then be received in the exact position in which it is found in the field.

In the case of very light, sandy, and porous soils, the wooden box may be at once inverted over the soil and forced down by pressure, and then dug out.

WATERS.—Two gallons of water are required for analysis. The water, if possible, should be sent in glass-stoppered Winchester half-gallon bottles, which are readily obtained in any chemist and druggist's shop. If Winchester bottles cannot be procured, the water may be sent in perfectly clean new stoneware spirit-jars surrounded by wickerwork. For the determination of the degree of hardness before and after boiling, only one quart wine-bottle full of water is required.

LIMESTONES, MARLS, IRONSTONES, AND OTHER MINERALS.—Whole pieces, weighing from 3 to 4 oz., should be sent enclosed in small linen bags, or wrapped in paper. Postage 2*d*., if under 4 oz.

OILCAKES.—Take a sample from the middle of the cake. To this end break a whole cake into two. Then break off a piece from the end where the two halves were joined together, and wrap it in paper, leaving the ends open, and send parcel by post. The piece should weigh from 10 to 12 oz. Postage, 4*d*. If sent by railway, one quarter or half a cake should be forwarded.

FEEDING MEALS.—About 3 oz. will be sufficient for analysis. Enclose the meal in a small linen bag. Send it by post.

On forwarding samples, separate letters should be sent to the laboratory, specifying the nature of the information required, and, if possible, the object in view.

POISONS.—Before a chemical examination is undertaken, a post-mortem should be made by a Veterinary Surgeon, or at the Royal Veterinary College, Camden Town, N.W., and only the necessary Viscera should be sent to the Laboratory for analysis, with a report on the post-mortem.

H. M. JENKINS, *Secretary*.

Members' Botanical and Entomological Privileges.

The Council have fixed the following Rates of Charge for the examination of Plants, Seeds, and Insects for the *bonâ fide* use of Members of the Society, who are particularly requested when applying to the Consulting Botanist, to mention the kind of examination they require, and to quote its number in the subjoined Schedule. The charge for examination must be paid to the Consulting Botanist at the time of application, and the carriage of all parcels must be prepaid.

I. BOTANICAL.

No.		
1.	—A report on the purity, amount and nature of foreign materials, perfectness, and germinating power of a sample of seeds	5s.
2.	—Detailed report on the weight, purity, perfectness, and germinating power of a sample of seeds, with a special description of the weeds and other foreign materials contained in it	10s.
3.	—Determination of the species of any weed or other plant, or of any epiphyte or vegetable parasite, with a report on its habits, and the means of its extermination or prevention	5s.
4.	—Report on any disease affecting the farm crop	5s.
5.	—Determination of the species of a collection of natural grasses found in any district of one kind of soil, with a report on their habits and pasture value	10s.

II. ENTOMOLOGICAL.

6.	—Determination of the species of any insect, worm, or other animal which, in any stage of its life, injuriously affects the farm crops, with a report on its habits and suggestions as to its extermination	5s.

INSTRUCTIONS FOR SELECTING AND SENDING SAMPLES.

In sending seed or corn for examination the utmost care must be taken to secure a fair and honest sample. If anything supposed to be injurious or useless exists in the corn or seed, selected samples should also be sent.

In collecting specimens of plants, the whole plant should be taken up, and the earth shaken from the roots. If possible, the plants must be in flower or fruit. They should be packed in a light box, or in a firm paper parcel.

Specimens of diseased plants or of parasites should be forwarded as fresh as possible. Place them in a bottle, or pack them in tinfoil or oil-silk.

All specimens should be accompanied with a letter specifying the nature of the information required, and stating any local circumstances (soil, situation, &c.) which, in the opinion of the sender, would be likely to throw light on the inquiry.

N.B.—*The above Scale of Charges is not applicable in the case of Seedsmen requiring the services of the Consulting Botanist.*

Parcels or letters (Carriage or Postage prepaid) to be addressed to Mr. W. Carruthers, F.R.S., Central House, Central Hill, Norwood, S.E.

The Council give notice that the following is the standard which is adopted by the Consulting Botanist in his examination of seeds:—

1. That the bulk be true to the species ordered.
2. That it contain not more than five per cent. of seeds other than the species ordered.
3. That the germinating power shall be, for cereals, green crops, clovers, and timothy grass, not less than 90 per cent.; for fox-tail, not less than 20 per cent.; and for other grasses not less than 70 per cent.

The Council recommend that purchasers should require a guarantee in accordance with this standard. They also strongly recommend that the purchase of prepared mixtures should be avoided, and that the different seeds to be sown should be purchased separately.

H. M. JENKINS, *Secretary.*

THE

JOURNAL

OF THE

ROYAL AGRICULTURAL SOCIETY

OF ENGLAND.

SECOND SERIES.

VOLUME THE EIGHTEENTH.

PRACTICE WITH SCIENCE.

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1882.

These experiments, it is true, are not easy; still they are in the power of every thinking husbandman. He who accomplishes but one, of however limited application, and takes care to report it faithfully, advances the science, and, consequently, the practice of agriculture, and acquires thereby a right to the gratitude of his fellows, and of those who come after. To make many such is beyond the power of most individuals, and cannot be expected. The first care of all societies formed for the improvement of our science should be to prepare the forms of such experiments, and to distribute the execution of these among their members.

Van Thaer, *Principles of Agriculture.*

London: Printed by William Clowes and Sons, Limited, Stamford Street and Charing Cross.

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DIRECTIONS TO THE BINDER.

The Binder is desired to collect together all the Appendix matter, with Roman numeral folios and place it at the *end* of each volume of the Journal, excepting Titles and Contents, and Statistics &c., which are in all cases to be placed at the *beginning* of the Volume; the lettering at the back to include a statement of the *year* as well as the *volume*; the first volume belonging to 1839–40, the second to 1841, the third to 1842, the fourth to 1843, and so on.

In Reports of the Journal all Appendix matter and, in one instance, an Article in the body of the Journal (which at the time had become obsolete), were omitted; the Roman numeral folios however (for convenience of reference), were reprinted without alteration in the Appendix matter retained.

ERRATA.

On p. 589, vol. xvii., lines 34–5, *for* "the prize-pens of Mr. Read, Mr. Lambert, and Mr. Parsons, put respectively first, second, and third," *read* "the prize-pens of Mr. Read, Mr. Parsons, and Messrs. J. A. and F. Palmer.'' On line 37, *for* "Mr. Parson's pen," *read* "Messrs. Palmer's pen."

On p. 257, vol. xviii, line 28, *for* "the best known," *read* "the least known." On p. 261, in the Table of Mixtures of Seeds for good or medium soils, the headings should read the same as the headings in pages 262 and 263.

METEOROLOGY; IMPORTATIONS OF GRAIN; SALES OF BRITISH WHEAT; PRICES OF CORN AND OTHER PRODUCE; AGRICULTURAL STATISTICS; AND STATISTICS OF DAIRY PRODUCE.

[*The facts are derived chiefly from the Meteorological Reports of* Mr. GLAISHER, *and the Returns of the* BOARD OF TRADE *and of the* INSPECTOR-GENERAL OF IMPORTS AND EXPORTS.]

METEOROLOGY.—1881.

First Quarter (*January, February, March*).—The mean reading of the barometer during the quarter was 29·70 and slightly below the average reading in the corresponding periods of 40 years; each monthly mean was below the average, the greatest deficiency occurring in February. The first few days in January were fine, but an exceptionally cold period set in on 7th and lasted until 27th, snow falling, with but one exception, on each day from 9th to 27th; February was, for the most part, wet, cold, and gloomy, with an excess of east wind, and frequent falls of snow; it was cold at the beginning and end of March, but warm and genial weather prevailed from 4th to 20th of the month. In January the mean temperature showed a deficiency of 4°·9, and the mean in February was 0°·9 below the average; whereas in March the mean temperature showed an excess of 1°·5. At the Royal Observatory the thermometer fell below the freezing-point of water on 18 days in January, 11 in February, and 11 in March; in all, on 40 days in the quarter. The lowest reading on each of these 40 days showed an aggregate of 274°·3 of frost. In the first quarter of 1879 there were 49 frosty days, but the aggregate degrees of frost did not exceed 185°·4. The first quarter of this year was colder than any corresponding period since 1855.

The falls of snow throughout the quarter were exceptional; snow fell on 53 days, and the snowstorm of the 18th day of January was very remarkable; this day was bitterly cold and there was a gale from the east, with driving snow that penetrated everywhere. The snow began to fall about 9.0 A.M., and at mid-

night, at Blackheath, in places free from drift, it was 15 inches in depth; nearly all the lines of railway out of London were blocked, and some of them early in the afternoon; trains were imbedded in the snow all night and during the next day. This snowstorm extended southward to Jersey and Guernsey, where the depth was from 12 inches to 14 inches, with drifts up to 4 and 5 feet. In the Isle of Wight the depth was about 15 inches, and the island was white with snow from the 17th to the 29th, a second heavy fall of 18 inches having taken place on the 20th; the total depth of snow which fell on these two days was therefore 33 inches. On the 18th the depth of snow at Brighton was 18 inches; in Cornwall and Devonshire it was from 12 to 14 inches, with drifts of from 10 to 12 feet. The amounts were less, proceeding northwards; at Cambridge the depth was 8 inches, and at Leeds and Bradford the fall was very small. The loss of life in England due to the snow was great, and small birds died in great numbers, their food being covered by the snow. Dr. Compton, of South Bourne, says, "Rooks were seen to kill and eat sparrows, and blackbirds to eat each other on my lawn, where a great congregation of birds were collected,"

The *mean temperature* of the air for the quarter was 37°·3, being 1°·4 below the average.

The *amount of rain or melted snow* measured at Greenwich during the quarter was 5·43 inches, which was nearly half an inch in excess of the average.

The number of hours of bright sunshine recorded during the quarter at the Royal Observatory, Greenwich, was 173·7, against 141·0, 137·5, and 235·9 in the three preceding corresponding quarters.

Second Quarter (*April*, *May*, *June*).—The mean reading of the barometer during the quarter was 29·84 inches, and slightly above the average for the corresponding period in 40 years; the mean showed an excess in April and May, and corresponded with the average in June.

The cold E. and N.E. winds, which set in towards the end of March, continued till the 10th of April, the sky being generally clear; the direction of the wind then changed to the S.W., but came back again on the 17th to a compound of the east. The weather was very cold at the beginning of the month; it was warm from the 10th to the 18th, and moderately cold afterwards. The fall of rain in the month was small.

The weather in May was cold at the beginning of the month, with a cloudy sky; then there were a few warm days, succeeded

by some very cold weather; on the 10th and 11th the temperature was everywhere low, the minimum at many places being below 32°, and at some as low as 22° and 23°; the thermometer on the grass was still lower. A great deal of damage was done to many crops by the severity of this May frost. During the remainder of the month the weather was for a few days warm, and then for a few days cold, and so alternately to the end of the month. Some warm rain fell in the middle of the month, and again at the end. The month was most favourable for agricultural work.

The weather during the first few days in June was warm, with the wind from the S.W.; the wind then changed to the N. and N.W., and continued so till the middle of the month. The remainder of the month was changeable, but was very favourable for all agricultural operations. On the 12th of June at 8 P.M. the Island of Alderney, which is 20 miles N.N.E. of Guernsey, was seen from there for 20 minutes as a mirage.

The mean daily temperature of the air was below the average till April 9th, the daily deficiency being $3\frac{1}{2}°$; from the 10th to the 18th the weather was warm, the average daily excess being 4°·7; from April 19th to May 22nd, the temperature was very variable, being for a few days together above the average, and then for a few days below the average, the latter, however, preponderating; the average deficiency of daily temperature for the 34 days ending May 22nd, was 1°·6; from May 23rd to June 4th there was a period of warm weather, the average daily excess of these 13 days being 5°·3; from June 5th to 14th there was a period of equally cold weather, the average daily deficiency being 5°·3; then for four days the temperature was 1°·8 in excess daily, and from June 19th to the end of the quarter the average daily deficiency of temperature was 1°·1.

The *mean temperature* of the quarter was 52°·9, and was 0°·6 above the average for the corresponding period in 110 years.

The *rainfall* measured at Greenwich during the quarter was 4·1 inches, which was 1·6 inches below the average amount in the corresponding periods of 66 years. The recorded amount was below the average in each month of the quarter, the largest deficiency occurring in April. Rain was measured on 8 days in April, 13 days in May, and 9 in June; in all, on 30 of the 91 days in the quarter. At 41 stations of observation the recorded rainfall of the quarter ranged from 3·25 inches at Strathfield Turgiss and 3·37 inches at Royston, to 10·30 and 10·34 inches, respectively, at Bolton and Stonyhurst.

The number of hours of bright sunshine recorded during the

quarter at the Royal Observatory, Greenwich, was 514·0, against 352·1 and 457·8 in the two preceding corresponding quarters.

Third Quarter (*July*, *August*, *September*).—The mean reading of the barometer during the quarter was 29·77 inches, and was slightly below the average for the corresponding period in 40 years; the mean showed an excess in July, but was below the average in August and September.

The weather in July was very different in different places, at many in England between the latitudes of 51° and 53° it was very fine, the temperature exceeding 90° on one or two days, and exceeding 80° on several days. The excessive heat caused a rapid ripening of crops, and the weather was all that could be desired for agricultural work in this part of the country; but in Wales, between the same parallels of latitude, the temperature reached 80° at only a few places, and with the exceptions of the 8th to the 16th, when the weather was fine, it was variable and showery. In Cumberland and Westmoreland the weather was cold and moist, the observer at Cockermouth says "the month was cold, cloudy, and wet, and was 1°·8 below the average of 19 years." In Cornwall and Devonshire the temperature was not remarkably high, and North of 53° the weather was cold. Tuesday, the 5th July, was generally a hot day, a thunderstorm occurred; and on July 6th, at many stations, the maxima shade temperatures were 20°, 30°, and 35° lower than the maxima temperatures of the preceding day. On the night of the 27th and 28th of July a remarkably low temperature occurred in Cornwall and Devonshire, extending into Wiltshire, seriously injuring young potatoes and French beans; the temperature of this night was the lowest in the quarter in those counties.

The weather in August during the first week was generally fine and dry, then cold, cloudy, and unseasonable during the remainder of the month, with almost constant rain, interfering most seriously with the ingathering of the harvest; wheat was generally injured, and in many places was mildewed. Falls of rain exceeding one inch in 24 hours took place at Bath on the 8th; at Strathfield Turgiss on the 11th; at Ramsgate on the 12th; at Hull twice, on the 16th and 23rd; at Wilton House twice, on the 19th and 20th; at Totnes and Torquay on the 22nd; at Osborne on the 23rd; at Leicester and Nottingham on the 24th; at Bolton twice, on the 25th and 29th; at Halifax on the 26th; at Somerleyton on the 29th; and at Barnet on the 30th. From the end of the first week to the end of the month, both the pressure of the atmosphere and the temperature of the air were below their averages.

The weather in September during the first half of the month was cold, and the readings of the barometer were below their averages, the remainder of the month was moderately fine; there were frequent showers of rain; the temperature of the dewpoint was above its average, whilst the temperature of the air was below its average, so that the air was more humid than usual and nothing would dry, greatly impeding harvest operations.

The *mean temperature* of the quarter was 60°·0, being 0°·3 above the average of 110 years.

The *rainfall* measured at Greenwich during the quarter was 8·19 inches, which was three-quarters of an inch below the average amount in the corresponding periods of 66 years. The recorded amount showed a considerable excess in August, whereas it was below the average both in July and September. Rain was measured on 12 days in July, 17 in August, and 15 in September; in all, on 44 of the 92 days in the quarter. At 41 stations of observation the recorded rainfall of the quarter ranged from 6·19 inches at Gloucester, to 14·85 inches at Lancaster, and 16·32 inches at Bolton.

The number of hours of bright sunshine recorded during the quarter at the Royal Observatory, Greenwich, was 420·4, against 410·6, the average amount of bright sunshine in the corresponding quarters of the four years 1877–80.

Fourth Quarter (*October*, *November*, *December*).—The mean reading of the barometer during the quarter was 29·81 inches, and was slightly above the average for the corresponding period in 40 years; the mean showed an excess in each month of the quarter, the largest excess occurring in October.

The weather in October was cold, and at times painfully so, with winds for the most part from S.E., E., and N.E. The month proved to be the coldest October about London for 64 years, although the October of the year 1842 was nearly as cold. On the 13th the barometer reading decreased rapidly, and the wind blew heavily from the north-west, increasing in strength during the night, to a very violent gale on the morning of the 14th. On this day great damage was done. About London, slates, tiles, and buildings in course of construction were blown down in great numbers. Large trees were uprooted, and during the morning locomotion was difficult and dangerous. The gale extended all over the country, many thousands of large trees being blown down; there was loss of life at many places, and great damage to property everywhere both on land and sea. The month was almost free from thunderstorms, and but little lightning was seen; snow fell

on the 15th at Wrottesley, and at this time the mountains in Wales were white with snow, as also were those in Cumberland at the end of the month.

The month of November was fine and warm, being a great contrast to that of October; the prevalent winds were from the W., S.W., and S., and there was almost a total absence of north and north-west winds. The mean temperature of the month at Greenwich was 48°·7, being 3°·4 warmer than in October, and warmer than in any November back to 1852, which was 48°·9. In the year 1818 the mean temperature of November was 49°·2, being the warmest November on record, and there was no other instance back to 1771 of so warm a November as this.

The weather in December for the first week was cloudy and generally warm; from the 8th to the 25th it was cold, with frequent fog, at times dense; on the 26th it became warmer, and continued so to the end of the year. The weather throughout the month was open. The range of readings of the barometer was great, being as large as 1°·5 at southern stations, increasing to 1°·8 and 1°·9 at northern stations. There was a good deal of fog at stations in the Midland counties.

The *mean temperature* of the air in the quarter was 44°·6, and 1°·2 above the average for the corresponding period in 110 years; the mean was 3°·5 below the average in October, whereas an excess of 6°·4 and 0°·8 respectively prevailed in November and December. At 41 stations of observation the mean temperature of the quarter ranged from 41°·9 at Wolverhampton to 48°·3 at Truro and in Guernsey.

The *rainfall* measured at Greenwich during the quarter was 7·52 inches, and was within the third of an inch of the average amount in the corresponding periods of 66 years. The recorded amount showed a slight deficiency in October and November, whereas it exceeded the average by rather more than half an inch in December. Rain was measured at Greenwich on 13 days in October, 16 in November, and 15 in December; in all, on 44 of the 92 days in the quarter. At 41 stations of observation the recorded rainfall of the quarter ranged from 7·22 inches at Holkham, to 18·40 inches at Totnes.

The number of hours of bright sunshine recorded during the quarter at the Royal Observatory, Greenwich, was 187·9, against 151·6, the average amount recorded in the corresponding quarters of the four years 1877–80.

TABLE I.—METEOROLOGICAL OBSERVATIONS RECORDED AT THE ROYAL OBSERVATORY, GREENWICH, IN THE FIRST SIX MONTHS OF THE YEAR 1881.

1881.	Temperature of										Elastic Force of Vapour.		Weight of Vapour in a Cubic Foot of Air.	
	Air.			Evaporation.		Dew Point.		Air—Daily Range.		Water of the Thames.				
MONTHS.	Mean.	Diff. from average of 110 years.	Diff. from average of 40 years.	Mean.	Diff. from average of 40 years.	Mean.	Diff. from average of 40 years.	Mean.	Diff. from average of 40 years.		Mean.	Diff. from average of 40 years.	Mean.	Diff. from average of 40 years.
	°	°	°	°	°	°	°	°	°	°	in.	in.	grs.	grs.
January ..	31·6	−4·9	−6·8	30·6	−6·4	28·0	−6·9	8·8	−0·8	..	0·153	−0·047	1·8	−0·5
February ..	37·7	−0·9	−1·8	36·3	−1·4	34·4	−0·8	9·0	−2·2	..	0·199	−0·009	2·3	−0·1
March ..	42·6	+1·5	+0·9	39·9	+0·6	36·6	+0·5	15·6	+1·0	..	0·217	+0·002	2·5	0·0
Means ..	37·3	−1·4	−2·6	35·6	−2·4	33·0	−2·4	11·1	−0·7	..	0·170	−0·018	2·2	−0·2
	°	°	°	°	°	°	°	°	°	°	in.	in.	grs.	grs.
April	45·9	−0·2	−1·2	42·2	−1·8	37·9	−2·6	18·1	−0·3	..	0·230	−0·023	2·6	−0·3
May	54·1	+1·6	+1·5	49·4	+0·6	44·7	−0·3	22·5	+2·1	..	0·296	−0·002	3·4	0·0
June	58·7	+0·5	−0·2	53·9	−0·7	49·6	−1·1	20·3	−0·7	..	0·356	−0·015	4·0	−0·1
Means ..	52·9	+0·6	−0·0	48·5	−0·6	44·1	−1·5	20·3	+0·4	..	0·294	−0·013	3·3	−0·1

NOTE.—In reading this Table it will be borne in mind that the *minus* sign (−) signifies *below* the average, and that the *plus* sign (+) signifies *above* the average.

TABLE II.—METEOROLOGICAL OBSERVATIONS RECORDED AT THE ROYAL OBSERVATORY, GREENWICH, IN THE LAST SIX MONTHS OF THE YEAR 1881.

1881. MONTHS.	Temperature of: Air. Mean.	Air. Diff. from average of 110 years.	Air. Diff. from average of 40 years.	Evaporation. Mean.	Evaporation. Diff. from average of 40 years.	Dew Point. Mean.	Dew Point. Diff. from average of 40 years.	Air—Daily Range. Mean.	Air—Daily Range. Diff. from average of 40 years.	Water of the Thames.	Elastic Force of Vapour. Mean.	Elastic Force of Vapour. Diff. from average of 40 years.	Weight of Vapour in a Cubic Foot of Air. Mean.	Weight of Vapour in a Cubic Foot of Air. Diff. from average of 40 years.
	°	°	°	°	°	°	°	°	°	°	in.	in.	grs.	grs.
July	65·4	+3·8	+3·3	59·7	+2·0	55·0	+1·0	22·8	+1·8	..	0·444	+0·026	4·8	+0·1
August ..	59·1	−1·8	−2·4	56·5	−1·0	54·2	+0·2	18·2	−1·5	..	0·421	+0·001	4·7	+0·1
September	55·4	−1·2	−1·8	53·8	−0·2	52·3	+1·2	15·8	−2·6	..	0·393	+0·013	4·4	+0·1
Means ..	60·0	+0·3	−0·3	57·0	+0·3	53·8	+0·8	18·9	−0·8	..	0·419	+0·013	4·6	+0·1
	°	°	°	°	°	°	°	°	°	°	in.	in.	grs.	grs.
October ..	45·3	−3·5	−4·8	43·5	−4·6	41·3	−4·6	13·4	− 1·3	..	0·261	−0·050	3·0	− 0·6
November ..	48·7	+6·4	+5·3	47·0	+5·8	45·1	+5·8	11·2	− 0·3	..	0·301	−0·057	3·4	+ 0·6
December ..	39·8	+0·8	−0·1	38·4	0·0	36·6	0·0	9·0	− 0·4	..	0·217	−0·020	2·5	− 0·1
Means ..	44·6	+1·2	+0·1	43·0	+0·4	41·0	+0·4	11·2	− 0·7	..	0·260	−0·001	3·9	0·0

NOTE.—In reading this Table it will be borne in mind that the *plus* sign (+) signifies *above* the average, and that the *minus* sign (−) signifies *below* the average.

TABLE III.—METEOROLOGICAL OBSERVATIONS RECORDED AT THE ROYAL OBSERVATORY, GREENWICH, IN THE FIRST SIX MONTHS OF THE YEAR 1881.

1881. MONTHS.	Degree of Humidity.		Reading of Barometer.		Weight of a Cubic Foot of Air.		Rain.		Daily Horizontal movement of the Air.	Reading of Thermometer on Grass. Number of Nights it was				
	Mean.	Diff. from average of 40 years.	Mean.	Diff. from average of 40 years.	Mean.	Diff. from average of 40 years.	Amount.	Diff. from average of 66 years.		At or below 30°.	Between 30° and 40°.	Above 40°.	Lowest Reading at Night.	Highest Reading at Night.
			in.	in.	grs.	grs.	in.	in.	Miles.				°	°
January ..	86	− 1	29·710	−0·056	561	+ 7	1·16	−0·74	256	27	4	0	10·2	38·0
February ..	88	+ 3	29·661	−0·125	553	0	2·43	+0·87	311	17	9	2	23·2	44·0
March ..	78	− 4	29·728	−0·019	549	− 1	1·84	+0·29	336	16	12	3	20·1	47·2
							Sum	Sum	Mean	Sum	Sum	Sum	Lowest	Highest
Means ..	84	− 1	29·700	−0·067	554	+ 2	5·43	+0·42	301	60	25	5	10·2	47·2
			in.	in.	grs.	grs.	in.	in.	Miles.				°	°
April ..	74	− 5	29·772	+0·016	546	+ 3	0·62	−1·04	357	14	10	6	24·3	43·1
May	71	− 5	29·929	+0·143	540	− 1	1·62	−0·46	286	6	14	11	21·9	55·3
June ..	72	− 2	29·806	0·000	532	0	1·86	−0·14	230	0	8	22	33·1	54·0
							Sum	Sum	Mean	Sum	Sum	Sum	Lowest	Highest
Means ..	72	− 4	29·836	+0·053	539	+ 1	4·10	−1·64	291	20	32	39	21·9	55·3

NOTE.—In reading this Table it will be borne in mind that the *plus* sign (+) signifies *above* the average, and that the *minus* sign (−) signifies *below* the average.

TABLE IV.—METEOROLOGICAL OBSERVATIONS RECORDED AT THE ROYAL OBSERVATORY, GREENWICH, IN THE LAST SIX MONTHS OF THE YEAR 1881.

1881. MONTHS.	Degree of Humidity.		Reading of Barometer.		Weight of a Cubic Foot of Air.		Rain.		Daily Horizontal movement of the Air.	Reading of Thermometer on Grass.				
										Number of Nights it was			Lowest Reading at Night.	Highest Reading at Night.
	Mean.	Diff. from average of 40 years.	Mean.	Diff. from average of 40 years.	Mean.	Diff. from average of 40 years.	Amount.	Diff. from average of 66 years.		At or below 30°.	Between 30° and 40°.	Above 40°.		
			in.	in.	grs.	grs.	in.	in.	Miles.				°	°
July	69	− 6	29·825	+0·027	525	− 3	2·13	−0·44	249	0	1	30	36·8	58·1
August ..	80	+ 3	29·676	−0·108	531	+ 3	3·88	+1·45	302	0	3	28	37·1	53·8
September	89	+ 8	29·801	−0·004	535	+ 3	2·18	−0·26	186	1	9	20	31·7	52·0
							Sum	Sum	Mean	Sum	Sum	Sum	Lowest	Highest
Means ..	79	+ 2	29·767	−0·028	530	+ 1	8·19	+0·75	246	1	13	78	31·7	58·1
			in.	in.	grs.	grs.	in.	in.	Miles.				°	°
October ..	86	− 1	29·827	+0·121	547	+ 8	2·70	−0·11	306	11	13	7	19·6	47·3
November	88	0	29·785	+0·037	542	− 6	2·27	−0·07	361	5	16	9	22·1	47·8
December	89	+ 1	29·821	+0·027	553	+ 1	2·55	+0·56	297	19	12	0	17·2	39·5
							Sum	Sum	Mean	Sum	Sum	Sum	Lowest	Highest
Means ..	88	0	29·811	+0·062	547	+ 1	7·52	+0·38	321	35	41	16	17·2	47·8

NOTE.—In reading this Table it will be borne in mind that the *plus* sign (+) signifies *above* the average, and that the *minus* sign (−) signifies *below* the average.

CORN: Importations, Sales, and Prices.

Table V.—Quantities of Wheat, Wheatmeal, and Flour, Barley, Oats, Peas and Beans, Imported into the United Kingdom in the Year 1881.

1881.	Wheat.	Wheatmeal and Flour.	Barley.	Oats.	Peas.	Beans.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
anuary ..	3,366,564	1,281,380	792,482	533,251	110,028	151,678
ebruary	3,771,808	1,069,531	506,624	159,196	110,895	165,056
arch ..	4,633,712	1,093,945	838,078	248,584	75,892	193,345
pril ..	3,995,452	1,037,077	931,629	783,074	127,866	173,346
ay ..	4,880,600	993,573	459,303	1,098,470	186,692	278,793
une ..	4,958,812	874,591	463,240	1,391,486	397,857	278,192
n first Six Months	25,606,948	6,350,097	3,991,356	4,214,061	1,009,230	1,240,410
uly	5,764,415	786,540	302,339	1,410,205	127,570	138,260
ugust ..	4,474,946	782,750	188,091	1,208,999	74,139	191,055
eptember	5,788,640	1,085,376	1,139,536	1,353,981	48,729	174,585
ctober ..	5,009,932	764,909	1,491,414	634,125	204,468	84,318
ovember	5,406,594	794,690	1,296,558	601,563	331,850	124,206
ecember	4,991,194	796,048	1,401,757	913,861	176,738	117,365
n last Six Months	31,435,721	5,010,313	5,819,695	6,122,734	963,494	829,789
Year ..	57,042,669	11,360,410	9,811,051	10,336,795	1,972,724	2,070,199

Note.—The average weights *per quarter* of corn, as adopted in the office of the Inspector-General of Imports and Exports, are as follow:—For wheat, $485\frac{1}{3}$ lbs., or $4\frac{1}{3}$ cwts.; for barley, 400 lbs., or $3\frac{4}{7}$ cwts.; for oats, 308 lbs., or $2\frac{3}{4}$ cwts. Corn has been entered by *weight* instead of *measure* since September, 1864. No duty has been charged since 1st June, 1869.

Table VI.—Computed Real Value of Corn Imported into the United Kingdom in each of the Seven Years, 1875-81.

	1875.	1876.	1877.	1878.	1879.	1880.	1881.
	£.	£.	£.	£.	£.	£.	£.
h t ..	27,418,970	23,140,766	33,820,084	27,397,487	31,329,500	30,604,285	31,466,804
ar ..	4,630,654	3,745,420	5,396,791	5,545,802	4,798,923	4,998,442	4,069,402
t. ..	5,407,928	4,619,427	4,998,864	4,553,946	4,500,760	4,946,440	3,781,013
ai ..	8,112,158	12,744,432	9,851,236	12,589,422	9,802,249	11,141,642	10,302,460
h kinds	2,304,218	2,555,397	2,321,922	1,463,433	1,634,064	1,920,787	1,617,820
n Flour	4,826,167	4,729,206	6,803,327	6,790,320	8,505,308	8,721,269	9,205,807
h kinds of Flour	12,130	15,474	17,284	32,214	25,585	36,845	24,007
tal of Corn ..	52,714,225	51,550,122	63,209,508	58,372,624	60,596,389	62,369,710	60,557,313

TABLE VII.—QUANTITIES of BRITISH WHEAT SOLD in the Towns from which Returns are received under the Act of the 27th & 28th VICTORIA, cap. 87, and their AVERAGE PRICES, in each of the TWELVE MONTHS of the YEARS 1875–81.

	QUANTITIES IN QUARTERS.						
	1875.	1876.	1877.	1878.	1879.	1880.	1881.
	quarters.	quarters.	quarters.	quarters.	quarters.	quarters.	quarters.
First month ..	210,661	154,367	152,557	146,848	183,223	124,422	122,533
Second month	223,974	188,539	173,729	164,387	237,861	142,857	119,219
Third month (five weeks)	292,172	208,367	213,718	174,025	234,469	136,613	164,942
Fourth month	233,970	160,868	150,012	146,933	197,918	106,170	120,177
Fifth month ..	234,683	174,153	132,231	166,909	227,295	104,125	130,235
Sixth month (five weeks)	216,016	188,611	122,390	137,981	229,307	127,132	113,386
Seventh month	121,684	90,626	77,674	82,597	105,139	71,622	57,333
Eighth month	135,456	88,030	89,759	119,611	71,525	54,641	49,329
Ninth month (five weeks)	199,314	314,327	225,659	272,699	75,374	153,752	197,351
Tenth month	226,503	216,393	217,046	329,564	96,261	197,757	231,960
Eleventh month	186,607	192,440	175,262	216,187	156,218	172,153	194,080
Twelfth month (five weeks)	234,035	225,254	212,627	276,943	207,511	218,641	215,547

	AVERAGE PRICES PER QUARTER.													
	1875.		1876.		1877.		1878.		1879.		1880.		1881.	
	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
First month ..	44	4	44	11	51	7	51	11	39	3	46	2	42	7
Second month	42	3	43	4	51	8	51	5	38	0	44	0	41	10
Third month (five weeks)	41	2	43	1	51	1	49	8	39	7	56	5	42	11
Fourth month	43	0	44	11	53	4	51	3	41	0	48	2	44	8
Fifth month ..	42	5	45	0	65	10	51	11	40	10	45	4	44	6
Sixth month (five weeks)	42	2	47	0	64	6	48	0	41	8	45	1	44	9
Seventh month	45	3	48	6	62	9	44	11	44	6	43	9	46	8
Eighth month	52	4	46	4	64	11	44	7	49	4	44	0	48	7
Ninth month (five weeks)	49	3	46	8	59	1	44	1	47	7	41	9	51	4
Tenth month ..	46	1	46	7	53	7	39	7	48	10	41	4	47	0
Eleventh month	47	4	48	0	52	3	40	1	49	4	43	7	45	11
Twelfth month (five weeks)	46	4	49	9	51	6	40	8	46	7	44	2	44	7

TABLE VIII.—AVERAGE PRICES of BRITISH CORN per Quarter (Imperial measure) as received from the INSPECTORS and OFFICERS of EXCISE according to the Act of 27th & 28th VICTORIA, cap. 87, in each of the FIFTY-TWO WEEKS of the YEAR 1881.

Week ending	Wheat.		Barley.		Oats.		Week ending	Wheat.		Barley.		Oats.	
	s.	d.	s.	d.	s.	d.		s.	d.	s.	d.	s.	d.
January 8..	43	4	31	6	19	10	July 9..	46	8	27	9	23	5
January 15..	42	1	32	1	19	5	July 16..	46	2	26	11	24	6
January 22..	42	4	32	7	20	4	July 23..	46	10	27	5	23	4
January 29..	42	6	32	5	20	2	July 30..	47	1	27	6	23	1
February 5..	42	7	33	2	20	3	August 6..	46	9	30	1	24	4
February 12..	42	3	32	9	20	6	August 13..	46	9	28	5	24	3
February 19..	41	8	32	1	20	7	August 20..	48	10	28	5	22	11
February 26..	40	9	31	10	20	10	August 27..	51	10	30	9	24	6
March 5..	41	7	31	7	21	2	September 3	55	2	32	10	24	2
March 12..	42	3	32	1	21	9	September 10	54	5	34	6	24	4
March 19..	43	7	31	8	21	10	September 17	51	1	35	7	22	8
March 26..	43	1	32	2	21	8	September 24	48	5	35	0	21	5
April 2..	44	1	32	2	22	4	October 1	47	9	35	1	19	11
Average of Winter Quarter	42	3	32	1	20	8	Average of Summer Quarter	48	10	30	4	23	7
April 9..	44	4	32	0	22	0	October 8..	46	9	34	10	20	2
April 16..	44	9	32	1	22	2	October 15..	47	1	34	9	19	7
April 23..	44	9	31	11	22	7	October 22..	47	1	35	8	20	6
May 30..	44	9	31	6	21	7	October 29..	47	0	35	4	20	2
May 7..	44	9	31	5	22	3	November 5	46	9	35	2	20	8
May 14..	44	10	30	9	22	5	November 12	46	3	34	9	20	7
May 21..	44	2	31	10	22	9	November 19	45	4	34	6	20	2
May 28..	44	1	31	9	24	1	November 26	45	4	33	6	19	11
June 4..	43	10	30	2	23	8	December 3	44	11	33	3	20	3
June 11..	44	8	31	1	23	2	December 10	44	9	32	6	20	2
June 18..	44	9	30	5	22	10	December 17	44	9	31	8	20	6
June 25..	45	0	30	3	23	8	December 24	44	4	31	6	20	1
July 2..	45	4	29	3	23	9	January 31	44	3	31	6	20	4
Average of Spring Quarter	44	6	31	4	22	8	Average of Autumn Quarter	45	10	33	10	20	2

TABLE IX.—QUANTITIES of WHEAT, BARLEY, OATS, PEAS, BEANS, INDIAN CORN or MAIZE, WHEATMEAL, and FLOUR, IMPORTED in the FOUR YEARS 1878–81; also the COUNTRIES from which the WHEAT, WHEATMEAL, and FLOUR were obtained.

	1878.	1879.	1880.	1881.
Wheat from—	cwts.	cwts.	cwts.	cwts.
Russia	9,032,930	7,975,144	2,880,108	4,018,895
Denmark	*	*	*	*
Germany	5,118,135	3,616,419	1,608,275	1,361,724
France	11,200	17,793	1,446	6,693
Turkey and Roumania ..	240,105	170,354	127,140	33,532
Egypt	217,498	2,064,397	1,590,957	1,070,488
United States	28,963,901	35,976,805	36,089,869	36,038,074
Chili	50,573	1,372,461	1,343,860	1,091,803
British India	1,819,304	887,256	3,247,242	7,308,842
Australia	1,459,850	2,245,657	4,267,743	2,978,130
British North America ..	2,603,586	4,676,686	3,893,544	2,860,854
Other countries	294,561	365,168	147,120	58,779
Total Wheat ..	49,811,643	59,368,140	55,197,304	57,042,669
Barley	14,162,028	11,541,098	11,685,527	9,811,051
Oats	12,765,789	13,482,607	13,862,430	10,336,795
Peas	1,804,733	1,916,777	2,141,438	1,972,724
Beans	1,870,508	2,310,101	2,574,759	2,070,199
Indian Corn, or Maize ..	41,631,348	36,078,586	37,153,658	33,429,722
Wheatmeal and Flour from—				
Germany	1,118,761	914,483	977,756	1,388,218
France	696,059	355,229	279,435	203,296
United States	3,635,200	6,863,172	6,908,352	7,696,415
British North America ..	294,448	460,435	521,702	260,342
Other countries	2,079,531	2,137,239	1,903,337	1,812,139
Total Wheatmeal and Flour	7,823,999	10,730,558	10,590,582	11,360,410
Indian Corn Meal	41,679	37,080	55,379	25,137

* Included under "Other Countries."

LE X.—AVERAGE PRICES of Consols, of Wheat, of Meat, and of Potatoes; also the AVERAGE NUMBER of PAUPERS relieved on the *last day* of each Week; and the MEAN TEMPERATURE, in each of the Twelve Quarters ending December 31st, 1881.

arters nding	AVERAGE PRICES.						PAUPERISM.		Mean Temperature.
	Consols (for Money).	Minimum Rate per Cent. of Discount charged by the Bank of England.	Wheat per Quarter in England and Wales.	Meat per lb. at the Metropolitan Meat Market (by the Carcass).		Potatoes (York Regents) per Ton, at Waterside Market, Southwark.	Quarterly Average of the Number of Paupers relieved on the *last day* of each week.		
				Beef.	Mutton.		In-door.	Out-door.	
	£.		s. d.						°
1879 r. 31	$96\frac{2}{8}$	3·38	39 0	$3\frac{7}{8}d.$—$7\frac{2}{8}d.$ Mean $5\frac{5}{8}d.$	$4\frac{4}{8}d.$—$8\frac{4}{8}d.$ Mean $6\frac{4}{8}d.$	118s.—144s. Mean 131s.	172,200	599,991	37·1
ne 30	$98\frac{4}{8}$	2·05	41 2	$4\frac{1}{8}d.$—$7\frac{2}{8}d.$ Mean $5\frac{6}{8}d.$	$4\frac{6}{8}d.$—$9d.$ Mean $6\frac{7}{8}d.$	128s.—161s. Mean 144s. 6d.	159,946	567,915	49·5
pt. 30	$97\frac{6}{8}$	2·00	47 2	$4d.$—$7\frac{6}{8}d.$ Mean $5\frac{7}{8}d.$	$4\frac{5}{8}d.$—$9d.$ Mean $6\frac{7}{8}d.$	182s.—233s. Mean 207s. 6d.	157,113	548,755	58·1
c. 31	98	2·60	48 1	$3\frac{6}{8}d.$—$7\frac{2}{8}d.$ Mean $5\frac{4}{8}d.$	$4\frac{4}{8}d.$—$7\frac{7}{8}d.$ Mean $6\frac{2}{8}d.$	136s.—160s. Mean 148s.	173,099	565,644	39·9
1880 ar. 31	98	3·00	45 1	$4d.$—$7\frac{5}{8}d.$ Mean $5\frac{7}{8}d.$	$4\frac{4}{8}d.$—$8\frac{2}{8}d.$ Mean $6\frac{3}{8}d.$	159s.—182s. Mean 170s. 6d.	182,836	595,908	39·8
ne 30	$98\frac{7}{8}$	2·93	46 1	$4\frac{2}{8}d.$—$8\frac{1}{8}d.$ Mean $6\frac{2}{8}d.$	$5d.$—$9\frac{3}{8}d.$ Mean $7\frac{2}{8}d.$	153s.—170s. Mean 161s. 6d.	168,661	555,196	52·4
pt. 30	98	2·50	43 0	$4\frac{2}{8}d.$—$7\frac{6}{8}d.$ Mean $6d.$	$4\frac{6}{8}d.$—$8\frac{6}{8}d.$ Mean $6\frac{6}{8}d.$	124s.—132s. Mean 128s.	162,879	539,670	61.4
ec. 31	$99\frac{2}{8}$	2·62	43 1	$4\frac{7}{8}d.$—$7\frac{6}{8}d.$ Mean $6\frac{3}{8}d.$	$5\frac{2}{8}d.$—$8\frac{6}{8}d.$ Mean $7d.$	99s.—112s. Mean 105s. 6d.	177,441	543,242	44·0
1881 ar. 31	$99\frac{1}{8}$	3·19	42 3	$4\frac{6}{8}d.$—$7\frac{2}{8}d.$ Mean $6d.$	$5d.$—$9d.$ Mean $7\frac{1}{8}d.$	..	191,578	591,071	37·3
ne 30	$101\frac{5}{8}$	2·65	44 6	$4\frac{2}{8}d.$—$7d.$ Mean $5\frac{5}{8}d.$	$5d.$—$9\frac{2}{8}d.$ Mean $7\frac{1}{8}d.$	..	173,074	558,941	52·9
pt. 30	$100\frac{2}{8}$	3·14	48 10	$4\frac{4}{8}d.$—$7\frac{2}{8}d.$ Mean $5\frac{7}{8}d.$	$5\frac{2}{8}d.$—$9d.$ Mean $7\frac{1}{8}d.$	..	164,567	538,057	60·0
ec. 31	$99\frac{5}{8}$	4·93	45 10	$4\frac{4}{8}d.$—$7\frac{4}{8}d.$ Mean $6d.$	$5d.$—$8\frac{7}{8}d.$ Mean $7d.$	..	178,058	539,515	44·6

TABLE XI.—ACREAGE under each Description of CROP, FALLOW, and IRELAND,

Description of Crops and Live Stock.	Great Britain. 1879.	1880.	1881.
CORN CROPS:—	Acres.	Acres.	Acres.
Wheat	2,890,244	2,909,438	2,805,809
Barley or Bere	2,667,176	2,467,441	2,442,334
Oats	2,656,628	2,796,905	2,901,275
Rye	49,127	40,781	41,567
Beans	444,228	426,667	440,201
Peas	277,831	234,470	216,790
TOTAL CORN CROPS	8,985,234	8,875,702	8,847,976
GREEN CROPS:—			
Potatoes	541,344	550,932	579,334
Turnips and Swedes	2,017,075	2,024,207	2,035,642
Mangold and Beetroot	363,561	343,116	348,872
Carrots and Parsnips	15,844	17,082	15,519
Cabbage, Kohl-rabi, and Rape	168,386	161,575	143,128
Vetches, Lucerne, and any other crop (except clover or grass)	448,108	379,741	388,073
TOTAL GREEN CROPS	3,554,318	3,476,653	3,510,568
OTHER CROPS, GRASS, &c.:—			
Flax	7,055	8,985	6,534
Hops	67,671	66,705	64,943
Bare fallow or uncropped arable land	721,409	812,566	795,809
Clover and artificial and other grasses under rotation	4,473,373	4,434,339	4,342,285
Permanent pasture, meadow, or grass not broken up in rotation (exclusive of heath or mountain land)	14,166,724	14,426,959	14,643,397
LIVE STOCK:—	No.	No.	No.
Cattle	5,856,356	5,912,046	5,911,642
Sheep	28,157,080	26,619,050	24,581,053
Pigs	2,091,559	2,000,842	2,048,090
Total number of horses used for agriculture, unbroken horses, and mares kept solely for breeding	1,432,845	1,421,180	1,424,938
Acreage of orchard, or of arable or grass-land, used also for fruit-trees	174,715	..	..
Acreage of woods, coppices, and plantations	2,187,078*	..	..

* As returned

and Grass, and Number of Cattle, Sheep, and Pigs, in Great Britain in 1879-81.

Ireland.			United Kingdom, including the Islands.		
1879.	1880.	1881.	1879.	1880.	1881.
Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
157,508	148,636	154,009	3,056,428	3,065,895	2,967,059
254,845	218,579	211,150	2,931,809	2,695,000	2,662,927
1,330,212	1,381,943	1,392,365	3,998,200	4,191,716	4,306,391
9,086	7,108	7,459	58,288	47,937	49,084
9,294	9,564	10,904	453,751	436,361	451,310
855	594	990	278,983	235,177	217,926
1,761,800	1,766,424	1,776,877	10,777,459	10,672,086	10,654,697
842,621	820,728	854,294	1,392,822	1,380,578	1,443,434
314,666	302,768	295,235	2,341,527	2,336,499	2,341,045
51,163	41,510	44,862	415,450	385,348	394,651
4,530	3,799	4,072	20,913	21,402	20,012
40,326	42,350	34,340	208,808	204,016	177,560
41,330	36,204	36,194	492,036	418,450	426,509
1,294,636	1,247,359	1,268,997	4,871,556	4,746,293	4.803,211
128,004	157,534	147,085	135,060	166,521	153,624
..	..	..	67,671	66,705	64,943
16,295	15,366	21,186	738,264	828,778	817,698
1,937,348	1,909,907	1,998,402	6,450,905	6,389,225	6,384,172
10,198,139	10,261,266	10,091,688	24,395,905	24,717,092	24,767,767
No.	No.	No.	No.	No.	No.
4,067,094	3,921,026	3,954,479	9,961,536	9,871,153	9,905,013
4,017,889	3,561,361	3,258,583	32,237,958	30,239,620	27,896,273
1,071,990	849,046	1,088,041	3,178,106	2,863,488	3,149,173
513,036	499,284	489,458	1,955,394	1,929,680	1,923,619
..	..	..	..	..	..
..	..	..	..	..	..

in 1872.

TABLE XII.—NUMBER of BEASTS exhibited and the PRICES realised for them at the CHRISTMAS MARKETS since 1843.

Year.	Beasts.	Prices.	Year.	Beasts.	Prices.
		s. d. s. d.			s. d. s. d.
1843	4,510	4 0—4 4	1863	10,372	3 6—5 2
1844	5,713	4 0—4 6	1864	7,130	3 8—5 8
1845	5,326	3 6—4 8	1865	7,530	3 4—5 4
1846	4,570	4 0—5 8	1866	7,340	3 8—5 6
1847	4,282	3 4—4 8	1867	8,110	3 4—5 0
1848	5,942	3 4—4 8	1868	5,320	3 4—5 8
1849	5,765	3 4—4 0	1869	6,728	3 6—6 2
1850	6,341	3 0—3 10	1870	6,425	3 6—6 2
1851	6,103	2 8—4 2	1871	6,320	3 10—6 2
1852	6,271	2 8—4 0	1872	7,560	4 6—6 0
1853	7,037	3 2—4 10	1873	6,170	4 4—6 6
1854	6,181	3 6—5 4	1874	6,570	4 4—6 8
1855	7,000	3 8—4 2	1875	7,660	4 6—6 6
1856	6,748	3 4—5 0	1876	7,020	4 4—6 4
1857	6,856	3 4—4 8	1877	7,510	4 6—6 0
1858	6,424	3 4—5 0	1878	6,830	4 6—6 0
1859	7,560	3 6—5 4	1879	5,620	4 0—6 4
1860	7,860	3 4—5 6	1880	7,660	4 0—6 0
1861	8,840	3 4—5 0	1881	8,150	4 0—6 0
1862	8,430	3 4—5 0			

TABLE XIII.—AVERAGE PRICES of BRITISH WHEAT, BARLEY, and OATS, per IMPERIAL QUARTER, in each of the NINETEEN YEARS 1863–81.

Year.	Wheat.	Barley.	Oats.	Year.	Wheat.	Barley.	Oats.
	s. d.	s. d.	s. d.		s. d.	s. d.	s. d.
1863	44 9	33 11	21 2	1873	58 8	40 5	25 5
1864	40 2	29 11	20 1	1874	55 9	44 11	28 10
1865	41 10	29 9	21 10	1875	45 2	38 5	28 8
1866	49 11	37 5	24 7	1876	46 2	35 2	26 3
1867	64 6	40 0	26 1	1877	56 9	39 8	25 11
1868	63 9	43 0	28 1	1878	46 5	40 2	24 4
1869	48 2	39 5	26 0	1879	43 10	34 0	21 9
1870	46 10	34 7	22 10	1880	44 4	33 1	23 1
1871	56 10	36 2	25 2	1881	45 4	35 11	21 9
1872	57 0	37 4	23 2				

TABLE XIV.—CERTAIN ARTICLES of FOREIGN and COLONIAL PRODUCTION IMPORTED in the YEARS 1878–81; and their QUANTITIES.

	1878.	1879.	1880.	1881.
ANIMALS, Living:				
Oxen, Bulls, and Cows, number	226,455	208,720	350,950	282,691
Calves .. .. ,,	27,008	39,172	38,999	36,683
Sheep .. .. ,, / Lambs .. .. ,,	892,126	944,869	940,991	935,244
Swine and Hogs .. .. ,,	55,911	52,267	51,030	24,273
Bones (burnt or not, or as animal charcoal) .. .. tons	85,773	65,067	79,740	65,007
Cotton, Raw .. .. .. cwts.	11,978,288	13,171,043	14,547,283	14,952,724
Flax .. .. ,,	1,553,664	1,694,051	1,896,249	1,781,762
Guano .. .. ,,	178,178	76,945	78,965	50,072
Hemp .. .. ,,	1,224,195	1,204,036	1,320,731	1,475,421
Hops .. .. ,,	169,512	262,616	196,688	146,710
Hides untanned: Dry .. ,,	565,909	545,373	660,198	554,134
,, ,, Wet .. ,,	595,221	463,086	584,693	457,295
Petroleum .. .. tuns	119,169	170,831	152,672	234,968
Oilseed Cakes .. .. .. tons	201,299	216,002	243,998	220,790
Potatoes .. .. cwts.	8,751,174	9,352,236	9,420,623	4,034,577
Butter .. .. ,,	1,795,413	2,045,606	2,319,802	2,046,421
Cheese .. .. ,,	1,965,949	1,789,168	1,773,503	1,834,480
Eggs .. .. .. great hundreds	6,529,036	6,388,838	6,228,437	6,306,645
Lard .. .. cwts.	908,187	838,897	929,616	855,792
Bacon .. .. ,,	3,466,565	3,996,922	4,370,860	3 858,855
Hams .. .. ,,	797,336	906,121	938,269	747,009
Salt Beef .. .. ,,	219,445	242,864	289,422	248,698
Salt Pork .. .. ,,	369,500	400,591	384,057	349,709
Clover Seeds .. .. .. ,,	305,049	345,206	271,609	279,925
Flax-seed and Linseed .. qrs.	1,990,529	1,665,333	1,712,576	1 829,838
Rape .. .. ,,	641,261	365,340	400,694	373,028
Sheep and Lambs' Wool .. lbs.	395,461,286	411,106,627	460,337,412	447,044,809

TABLE XV.—QUANTITY and VALUE of MEAT IMPORTED in the 6 YEARS, 1876–81.

QUANTITIES.	1876.	1877.	1878.	1879.	1880.	1881.
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
Beef, Salted or Fresh ..	413,351	678,505	723,558	806,462	1,008,089	1,061,467
Meat, ,, ,, ..	92,556	130,178	145,493	151,505	148,788	177,931
Total	505,907	808,683	869,051	957,967	1,156,877	1,239,398
Meat, Preserved otherwise than by salting	283,066	469,003	438,903	566,758	655,600	575,929
Total Meat ..	788,973	1,277,686	1,307,954	1,524,725	1,812,477	1,815,327
VALUES.						
	£.	£.	£.	£.	£.	£.
Beef, Salted or Fresh ..	943,580	1,686,392	1,753,066	1,919,922	2,399,324	2,644,165
Meat, ,, ,, ..	281,830	388,933	426,864	436,317	428,285	515,812
Total	1,225,410	2,075,325	2,179,930	2,356,239	2,827,609	3,159,977
Meat, preserved otherwise than by salting	887,035	1,434,234	1,313,541	1,688,321	1,903,036	1,638,938
Total Meat ..	2,112,445	3,509,559	3,493,471	4,044, 560	4,730,645	4,798,915

The quantity of meat imported in 1878 was 1,307,954 cwts., against 1,277,686 in the previous year; in 1879 the quantity was 1,524,725 cwts., being an increase over that of the previous year of 216,771 cwts.; in 1881 the quantity had still further increased to 1,815,327 cwts.

The average price of beef per lb. by the carcass at the Metropolitan Meat Market was $5\frac{5}{8}$*d.* in 1879; in 1878 it was $6\frac{2}{8}$*d.*, showing a reduction in 1879 of 10 per cent. The average price of mutton per lb. was $6\frac{5}{8}$*d.* in 1879; in 1878 it was 7*d.*, showing a reduction in 1879 of 5 per cent.; in 1880 the average price of beef per lb. was $6\frac{1}{8}$*d.*, of mutton per lb. $6\frac{7}{8}$*d.*, showing an increase over the previous year of 9 per cent. and 4 per cent respectively.

The reduction in the price of beef and mutton since 1878 was equal to 6 and 4 per cent. respectively.

In 1881 there was a decrease, compared with the previous year, in the number of oxen, bulls, and cows of 68,859, and there was a decrease in swine and hogs of 26,757; the number of sheep and calves in that year had also diminished to 5747 and 2316 respectively.

In 1881 the average price of beef per lb. was $5\frac{7}{8}$*d.*; of mutton per lb. $7\frac{1}{8}$*d.*, showing a decrease in the price of the former—as compared with the year 1880—of 4 per cent., and an increase in the price of the latter of 4 per cent.

STATISTICS OF DAIRY PRODUCE.

The following remarks relating to Butter and Cheese are extracted from 'The Grocer':—

Cork Butter Market.—In the events of the past year itself there is little of note to refer to. It commenced with a prospect of brisk demand and a good sale for those stocks of first and second quality, which, as an act of precaution against the season of non-production, the Cork exporters must necessarily provide themselves with at the end of every season. These butters they select with the greatest possible care for their keeping qualities, and they are so well preserved in store that they turn out in January, February, and March in very prime condition, and were it not for those supplies thus provided by the Cork exporters, the buyers of fine butters would be completely at the mercy of the foreigners in winter. Contrary to expectation, the demand dropped off early in the winter, and prices experienced a downward tendency till May and June, and some holders of stocks in Cork were punished severely by the fall. From June the turn in prices began, and in July Cork butter joined the upward tendency of other Irish butters, caused by the knowledge that supplies from America were about to fail in

consequence of the extreme heat. After once this autumn advance had ceased, till supplies began to drop off in December, there was no great change in prices of fine butter. The usual advance in October did not take place this year, partly because prices were already high and partly because buyers on this side did not go into stock this winter as in former years. The Cork prices now at the close of the year stand at figures which make each quality good value, and will serve as a useful check on the inclination to force foreign butters to extravagant prices. We learn that for many years there has not been so very little butter held in the farmers' hands as now, nor so little stock held by Cork exporters. The good prices available all the year induced farmers to sell according as it was made, and the experience of last year frightened many merchants from putting in stock. A great scarcity of Cork butter may be looked for this winter.

The unusual occurrence of a "strike" in the Cork butter market was one of the closing events of the year, and though it lasted less than a week it did the market great harm, as it diverted a good many orders elsewhere, and caused a heavy fall in prices at a season when they should naturally advance. The market ends this year, as it has done for some years past, financially embarrassed, notwithstanding its immense annual revenue.

Cork Butter.—The sale has been greatly lessened by some of the shippers, who have been sending travellers round to call on retailers in this country, offering to sell them small quantities at the same prices asked for large quantities here. The beginning of January *first* qualities were offered for sale here at 141*s.* to 143*s.*; at the end of the month they were 140*s.* to 148*s.* Quotations then ceased for them until the beginning of the new season's brands in May. The range in the prices of *seconds* was great, varying according to the freshness, some being sent from country dealers for resale in this market. Quotations for seconds in January varied from 136*s.* to 144*s.*; early in February, from 115*s.* to 144*s.*; at the end of the month, 115*s.* to 138*s.*; early in March, 112*s.* to 135*s.*; at the end of the month, 90*s.* to 125*s.*; early in April, 80*s.* to 135*s.*; new, the third week in April, 122*s.* to 124*s.*, the last week, 106*s.* *Thirds*, the first week in January, 111*s.* to 113*s.*, then for the remainder of the month, 103*s.* to 111*s.*; in February they varied from 103*s.* to 110*s.*; March, 77*s.* to 100*s.*; April, 70*s.* to 100*s.*, early in the month, and new at the latter end, 84*s.* to 85*s.* In the beginning of May *firsts* were 136*s.*, at the end of the month, 106*s.*; June, began 106*s.* to 107*s.*, the last week, 112*s.* to 113*s.*; in July they varied from 115*s.* to 120*s.*; August, 118*s.* to 121*s.*; September, 121*s.*; October, 121*s.* to 125*s.*; early in November,

122*s.*, at the end of the month, with lessened supplies, 130*s.* to 135*s.*; December, 135*s.* to 138*s.* *Seconds*, early in May, 107*s.* to 109*s.*, at the end of the month, 98*s.*; in June they varied from 98*s.* to 111*s.*; July, 110*s.* to 115*s.*; August, 114*s.* to 115*s.*; September and October, 116*s.* to 119*s.*; November, 108*s.* to 113*s.*; December, 111*s.* to 120*s.* *Thirds*, early in May, 107*s.* to 109*s.*, the end of the month, 98*s.*; in June they varied, 98*s.* at the beginning, to 112*s.* at the close of the month; July and August, 100*s.* to 107*s.*; September and October, 100*s.* to 112*s.*; November, 94*s.* to 98*s.*; December, 89*s.* to 97*s.* The quotations represent the landed prices.

Irish Butter.—We are informed from all parts of Ireland that for many years past there never was such a scarcity of butter in that country as there is just at present. In former years both farmers and merchants held stocks for the months of January, February, and March. This proved so disastrous last year that very few kept any on hand this season, and it is now discovered on the appearance of any demand that there are no supplies to meet it. There is, practically, no butter being made just now, nor can there be any till the beginning of April. The one market which furnishes any reliable statistics—Cork—shows average receipts at present of about 70 firkins daily, as compared with an average of about 200 daily at this time in other years. These will be gradually lessening, and the quality of these is only thirds and fourths. In addition to the larger daily supplies in former years there were good stocks held; now there are none. An idea of how bare the Irish markets are may be formed from the fact that they are importing for local consumption large quantities of Danish and American butter and butterine.

Foreign Butter.—The weather—very severe in the early part of the year, the summer hot and dry, and the latter part of the year mild and wet—had a telling effect upon this market. Danish Butter.—The quotations were for first and second qualities in the early part of January, 135*s.* to 160*s.*, the latter end, 145*s.* to 164*s.*; February, 150*s.* to 160*s.*; early in March, 140*s.* to 160*s.*; then 130*s.* to 145*s.*, and from the end of the month to the end of April, 124*s.* to 140*s.*; from the opening of May to the first week in June they varied from 120*s.* to 136*s.*, and 120*s.* to 125*s.*; July, early, 120*s.* to 130*s.*, the latter end, 128*s.* to 135*s.*; in the beginning of August, 130*s.* to 140*s.*; then to the second week in September, 136*s.* to 140*s.*; at the end, 125*s.* to 140*s.*; October began at 130*s.* to 145*s.*, and finished at 142*s.* to 150*s.*; at the end of November they were 150*s.* to 160*s.*, and varied little to the latter end of December. Best Normandys the first week in January were

132*s.* to 140*s.*, the last week, 145*s.* to 156*s.*; seconds ranged from 10*s.* to 15*s.* below firsts throughout the month, and thirds 12*s.* to 20*s.* below seconds. Firsts, early in February, were 138*s.* to 152*s.*, and to the first week in March 2*s.* less; seconds 15*s.* to 20*s.* below firsts, and thirds 15*s.* to 25*s.* under seconds. Firsts, from the middle of March to the third week in April, 120*s.* to 142*s.*; seconds for the same time, 10*s.* to 20*s.* less. Firsts, the end of April, 125*s.* to 130*s.*; lower qualities 10*s.* to 15*s.* less. Firsts in the beginning of May were 120*s.* to 126*s.*, at the end of the month, 112*s.* to 120*s.*; seconds 10*s.* less. Firsts, early in June, 112*s.* to 115*s.*, and varied little to third week. In July, seconds for the same time 8*s.* to 10*s.* less. Firsts, from the last week in July to the second week in October varied little, beginning at 124*s.* to 126*s.*, and finishing at 124*s.* to 128*s.*; lower qualities began at 108*s.* to 118*s.*, and the second week in October, 105*s.* to 120*s.* Firsts, the third week in October, 132*s.* to 136*s.*; the first week in November, 130*s.* to 138*s.*, the last week, 126*s.* to 132*s.* With a falling-off in fine qualities, the prices for them advanced considerably, varying from 138*s.* to 150*s.* at end of December; inferior qualities ranged from 105*s.* to 128*s.* Jerseys, early in January, 110*s.* to 130*s.*; at the end of the month, 115*s.* to 122*s.*; first week in February, 120*s.* to 140*s.*, then to the second week in March, 120*s.* to 130*s.*; early in April, 110*s.* to 135*s.*, then 110*s.* to 130*s.*, and at the end of the month, 110*s.* to 125*s.*; at the beginning of May, 110*s.* to 120*s.*; then gradually downwards at the close to 100*s.* to 108*s.*; early in June, 96*s.* to 102*s.*; at the close of the month, 94*s.* to 104*s.*; throughout July, 96*s.* to 104*s.*; and throughout August, 100*s.* to 110*s.*; early in September, 98*s.* to 104*s.*; at the close, 105*s.* to 110*s.*; October the prices began at 100*s.* to 102*s.*, and finished at 96*s.* to 116*s.*; early in November, 96*s.* to 120*s.*, and scarcely varied throughout the month; early in December, 105*s.* to 125*s.*; at the close, 105*s.* to 130*s.*

Bosch Butter.—The quotations throughout the year did not materially vary, the lowest ones for weeks consecutively being 35*s.* for inferior, and 70*s.* for best; the more general ones, 50*s.* to 70*s.*, and with a few exceptions, 65*s.* to 90*s.*

Dutch Butter.—Always a fluctuating market. In the beginning of January, 130*s.* to 140*s.*; at the end of the month, 146*s.* to 158*s.* Early in February, 140*s.* to 146*s.*; the middle of the month, 136*s.* to 156*s.*; and at the end, 130*s.* to 152*s.* March began with prices 120*s.* to 150*s.*, and closed at 120*s.* to 132*s.* April, early, 120*s.* to 130*s.*; closing at 112*s.* to 120*s.* May, early, 112*s.* to 116*s.*; the last week, 90*s.* to 108*s.* The second week in June, 110*s.* to 118*s.*; the last week, 106*s.* to 112*s.* Early in July, 112*s.* to 115*s.*; the latter

end 124*s.* to 135*s.* August varied but little, beginning at 126*s.* to 132*s.*, and closing at 2*s.* less. September commenced at 120*s.* to 126*s.*; the second week, 124*s.* to 130*s.*; the end of the month, 122*s.* to 128*s.* The first week in October, 122*s.* to 132*s.*; the end of the month, 130*s.* to 140*s.* Early in November, 110*s.* to 120*s.*; at the end of the month, 100*s.* to 134*s.* In December prices varied from 120*s.* to 150*s.*

American Butter.—The state of the weather in the United States had a great effect upon the prices of American butter. In January quotations varied from 100*s.* for second-rate qualities to 130*s.* for best. In February they varied from 90*s.* to 135*s.* Early in March, 80*s.* to 130*s.*; at the close, 60*s.* to 120*s.* April, in the beginning, 60*s.* to 120*s.*; at the end, 50*s.* to 110*s.* First week in May, 45*s.* to 90*s.*; last week, 45*s.* to 95*s.* In June prices varied from 48*s.* to 98*s.*, and 90*s.* to 112*s.* July, early, 102*s.* to 112*s.*; then, with hot, parching weather, steadily advancing to 60*s.* to 125*s.* at the close. August, about the same prices. In September they varied from 60*s.* to 124*s.* October, the first week, 60*s.* to 120*s.*; then 60*s.* to 122*s.*; and the third and fourth weeks, 60*s.* to 120*s.* In November, with very little of good quality, the quotations were 60*s.* to 122*s.* to the end of the month. December, 60*s.* to 124*s.*

Cheese.—In best English Cheese the fluctuations in prices were very few; but for other descriptions the prices ranged widely apart, and were difficult to quote. The general figures for best Cheddar were 76*s.* to 81*s.* For other English makes, prices were so variable that it is useless to attempt reliable quotations.

American Cheese.—A very severe winter, and a dry, hot, and parching summer, checking vegetation, are said to have materially affected the make of cheese, and in some cases the quality also, causing a considerable difference between the prices of first-class parcels and those of other descriptions. Best qualities from the beginning of the year to the end of the month of May ranged from 68*s.* to 72*s.*; other qualities from 54*s.* to 66*s.* In June supplies of new began to arrive—prices then 52*s.* to 56*s.*—and at the end of August bests were 56*s.* to 60*s.*; lower qualities, 42*s.* to 50*s.* From the beginning of September to the end of October first qualities varied from 60*s.* to 68*s.*; lower grades from 45*s.* to 58*s.* Some parcels that were seriously affected by the state of the weather were difficult to sell at still lower prices. From the beginning of November to the close of December prices for best varied from 64*s.* to 70*s.*, the latter an extreme quotation; second-rates and inferiors for the same time, 40*s.* to 60*s.*

The following Quotations, &c., are extracted from 'The Grocer.'

TABLE XVI.—AVERAGE and CURRENT PRICES of BUTTER and CHEESE on 1st SATURDAY in JANUARY of each YEAR, from the latest actual MARKET SALES.

	Average Annual Price in the 5 years, 1870–74.	Average Annual Price in the 5 years, 1875–79.	Current Price, 1st January, 1880.	Current Price, 1st January, 1881.	Current Price, 1st January, 1882.
	Per cwt. s. s.	Per cwt. s. s.	Per cwt. s. s.	Per cwt. s. s.	Per cwt. s. s.
Butter:					
Carlow, finest, F.O.B	126 to 136	131 to 144	126 to 140	120 to 140	112 to 138
,, Landed ..	124 ,, 138	138 ,, 148			
Cork, 1sts..	138 ,, 143	143 ,, 148	145 ,, ..	141 ,, ..	136 ,, 140
,, 2nds	129 ,, 135	133 ,, 137	143 ,, ..	132 ,, 135	129 ,, 131
,, 3rds, new ..	111 ,, 116	108 ,, 109	115 ,, ..	105 ,, ..	131 ,, 113
,, 4ths	98 ,, 98	90 ,, 91	96 ,, ..	78 ,, ..	82 ,, ..
Limerick	117 ,, 121	124 ,, 129			
Foreign:					
Friesland	113 ,, 130	132 ,, 137	128 ,, 134	120 ,, 130	125 ,, 144
Jersey, &c.	79 ,, 129	94 ,, 134	125 ,, 136	110 ,, 125	110 ,, 140
Kiel	111 ,, 145	135 ,, 164	.. ..	.. ..	.. ..
Normandy	93 ,, 150	92 ,, 151	120 ,, 146	108 ,, 140	.. ..
American	82 ,, 115	81 ,, 121	90 ,, 135	95 ,, 125	60 ,, 122
Bosch	.. ..	.. ..	65 ,, 95	65 ,, 84	50 ,, 85
Cheese:					
English Cheddar, fine, new	76 ,, 90	72 ,, 90	72 ,, 86	76 ,, 90	76 ,, 82
,, good, new	74 ,, 93	.. ..	.. ..	.. ..	.. ..
Red Somerset Loaf..	68 ,, 81	77 ,, 87	74 ,, ..	76 ,, 82	74 ,, 78
White or yellow Cheddar Loaf ..	72 ,, 81	78 ,, 87	.. ..	.. ..	.. ..
Scotch Cheddar ..	67 ,, 77	164 ,, 189	.. ..	.. ..	.. ..
Cheshire, new.. ..	76 ,, 87	78 ,, 86	64 ,, 86	74 .. 88	72 ,, 82
,, good ditto	58 ,, 70	53 ,, 71	.. ..	.. ..	.. ..
Wiltshire, new ..	67 ,, 78	70 ,, 79	62 ,, 76	70 ,, 80	64 ,, 74
,, good ditto	57 ,, 64	60 ,, 68	.. ..	.. ..	.. ..
North Wilts Loaf, new	66 ,, 80	72 ,, 81	.. ..	72 ,, 82	76 ,, 81
Derby ,, ,,	65 ,, 83	74 ,, 64	70 ,, 74	76 ,, 84	60 ,, 74
Foreign:					
American, fine ..	68 ,, 73	63 ,, 67	64 ,, 68	68 ,, 72	60 ,, 68
,, good ..	54 ,, 65	41 ,, 59	56 ,, 60	56 ,, 66	42 ,, 60
Gouda	49 ,, 64	52 ,, 61	56 ,, 62	60 ,, 66	56 ,, 62
Edam, new	53 ,, 68	56 ,, 65	56 ,, 64	62 ,, 68	57 ,, 64
Gruyère, new	.. ..	76 ,, 85	71 ,, 78	62 ,, 82	72 ,, 75

TABLE XVII.—QUANTITY and VALUE of BUTTER IMPORTED from DENMARK, 1865–80.

Years.	Quantities.	Computed Real Value.	Years.	Quantities.	Computed Real Value.
	Cwts.	£.		Cwts.	£.
1865	65,555	362,440	1873	201,558	1,203,459
1866	67,305	319,528	1874	226,053	1,363,433
1867	80,589	422,479	1875	206,171	1,275,870
1868	79,437	471,262	1876	205,195	1,311,234
1869	103,613	574,981	1877	210,322	1,347,791
1870	127,013	767,190	1878	242,427	1,517,467
1871	140,851	803,226	1879	281,740	1,673,452
1872	173,574	1,009,322	1880	300,157	1,777,176

TABLE XVIII.—QUANTITY and VALUE of BUTTER Imported from the UNITED STATES, BELGIUM, FRANCE and HOLLAND; and of CHEESE Imported from the UNITED STATES and HOLLAND, 1866–80.

Years.	UNITED STATES.			
	BUTTER.		CHEESE.	
	Quantities.	Computed Real Value.	Quantities.	Computed Real Value.
	Cwts.	£.	Cwts.	£.
1866 ..	16,059	77,754	415,726	1,386,447
1867 ..	39,035	113,290	526,740	1,470,017
1868 ..	7,117	37,279	489,117	1,439,380
1869 ..	17,203	84,603	487,870	1,612,325
1870 ..	16,915	80,928	555,385	1,861,263
1871 ..	83,775	394,359	731,326	2,014,805
1872 ..	45,765	199,679	598,198	1,701,435
1873 ..	43,406	199,639	790,238	2,353,181
1874 ..	36,307	188,769	849,933	2,589,776
1875 ..	40,331	205,900	958,978	2,786,027
1876 ..	118,131	593,122	936,203	2,564,977
1877 ..	188,491	920,561	1,082,844	3,129,829
1878 ..	219,794	998,766	1,345,745	3,306,612
1879 ..	301,054	1,243,075	1,214,959	2,467,651
1880 ..	277,790	1,343,967	1,171,498	3,411,625

Years.	BELGIUM.—BUTTER.		FRANCE.—BUTTER.	
	Cwts.	£.	Cwts.	£.
1866 ..	76,667	426,712	452,196	2,276,493
1867 ..	80,754	470,464	450,693	2,265,147
1868 ..	70,456	405,987	393,578	2,156,824
1869 ..	85,789	481,609	407,432	2,231,450
1870 ..	84,408	516,643	289,692	1,672,899
1871 ..	94,539	523,460	304,683	1,636,006
1872 ..	74,191	409,555	355,089	1,916,795
1873 ..	76,610	439,501	446,550	2,409,861
1874 ..	76,723	465,517	713,251	3,944,233
1875 ..	79,950	499,028	567,560	3,387,219
1876 ..	65,309	419,209	622,488	3,732,405
1877 ..	58,200	378,435	606,762	3,654,488
1878 ..	80,073	499,889	555,272	3,179,326
1879 ..	63,032	391,166	438,725	2,264,591
1880 ..	53,259	302,993	531,649	2,826,586

Years.	HOLLAND.			
	BUTTER.		CHEESE.	
	Cwts.	£.	Cwts.	£.
1866 ..	383,225	1,979,070	426,559	1,317,231
1867 ..	326,217	1,733,459	332,628	961,245
1868 ..	343,322	1,992,414	329,565	959,547
1869 ..	415,176	2,253,420	426,913	1,262,101
1870 ..	406,795	2,388,459	422,553	1,204,830
1871 ..	390,616	1,986,708	348,148	954,236
1872 ..	269,091	1,358,579	329,535	942,537
1873 ..	279,004	1,453,875	336,654	1,013,233
1874 ..	351,605	1,877,755	398,888	1,164,921
1875 ..	357,106	1,917,910	370,123	1,078,594
1876 ..	402,984	2,252,909	330,435	949,413
1877 ..	372,134	2,084,686	341,980	984,855
1878 ..	460,601	2,494,903	355,159	1,018,669
1879 ..	655,377	3,331,149	275,039	743,107
1880 ..	810,509	4,076,399	288,666	810,590

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ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

XXII.—*Dentition as indicative of the Age of the Animals of the Farm.* By Professor G. T. Brown, of the Veterinary Department of the Privy Council.

Early maturity is the *sine quâ non* of breeders and exhibitors of farm stock, and it is one of the objects of Agricultural Societies to encourage them in their efforts to produce breeds which reach a state of perfect development at a comparatively youthful period. In order that judges of stock may be in a position to decide between animals of undoubted merit, the age is in all cases to be taken into account; and it is presumed that of the competing animals, which are in other respects equal, the youngest will receive the palm. Whether or not the practice is invariably in conformity with this theory may be open to question, but there is no doubt that the principle is correct, and in order that it may be carried into effect it is necessary to inform the judges of the exact age of each animal in every class.

No argument is required to show that the breeder's certificate would afford the most reliable evidence of an animal's age, if scrupulous exactitude and honesty were inherent human qualities; it is equally obvious that, in their absence, the evidence of a certificate is more calculated to mislead than to assist the judgment.

It will probably be conceded that persons who are concerned with the breeding and feeding of animals are not always free from risk of error, and it certainly can be proved by the logic of facts that all are not scrupulously exact in such matters as the statement of an animal's age. It therefore becomes necessary to supplement or correct the exhibitor's certificate by such evidence as the animal itself affords; and by common consent the periodical changes to which the teeth are subject are accepted as

indications of age, only second in value to positive proof of the date of the animal's birth.

How far the cultivation of breeds by artificial selection and high feeding has influenced the development of the teeth in common with other organs connected with nutritive functions can only be inferred from the great difference which exists between the accounts of the older veterinary writers on dentition of animals, and the facts which are familiar to the few experts of this generation who have taken the trouble to investigate the subject for themselves.

In this country the most popular writer on veterinary science was Mr. Youatt, whose works on the horse, ox, sheep, and pig were published by the Society for the Diffusion of Useful Knowledge. Youatt's remarks on the teeth are copied almost verbatim from M. Girard's work on dentition ; and it may be without hesitation asserted, that if Girard's description of the teeth of the ox, sheep, and pig were correct at the time when they were written, an improved system of breeding and feeding must have occasioned a very remarkable change in the rate of development of the teeth. In the year 1850 I commenced some investigations on the animals which were bred on the Royal Agricultural College Farm, for the common purposes of supplying milk and meat, and not specially for purposes of exhibition. The cattle on the farm were chiefly Shorthorns, the sheep were Cotswolds, and the pigs Berkshire, and none of the animals were at that time referred to as pedigree stock, nor were they fed on the forcing system. The observations of the first few months of 1850 sufficed to establish the fact that the teeth of cattle, sheep, and swine were developed at much earlier periods than those which were stated in Youatt's remarks, copied from Girard.

From the animals on the College Farm the inquiry was extended to Mr. Stratton's valuable stock, near Swindon ; and to Mr. Kearsey's ram flock at Rodmarten. Among the more highly cultivated animals on these farms the process of dentition was not found to be more forward than among the stock on the College Farm ; and it is not generally more forward at the present time, after an intervening period of over thirty years of high feeding and careful breeding, in the improved races of cattle, sheep, and swine than it was then.

The contention of exhibitors is that exceptional development is so frequent during dentition as to disturb any calculations which are based on a rule. In reply it may be stated that the most competent observers do not accept that view. On the contrary, they are aware that the alleged exceptions do not often bear a critical investigation. Numerous inquiries

have from time to time been made in compliance with the urgent demands of owners of disqualified animals; and those who have been most sedulous in searching for the truth are aware how vague and incomplete the evidence in support of the owners' certificate has been in most cases. Not uncommonly the entry has been proved to be incorrect, and in the few cases where the decision of the expert has been reversed, it has been done only on the plea that the exhibitor should have the benefit of the doubt.

Whenever a considerable number of disqualifications occur at the principal Agricultural Shows the aggrieved exhibitors avail themselves of the aid of the press to vindicate their systems of recording the ages of their animals, and to show how impossible it is for any mistake to happen. In no case, however, within my own recollection, have any useful facts been brought to light as the result of these periodical effusions.

On the occasion of the exhibition of the Smithfield Club in 1881 several pens of pigs were disqualified, and some of the exhibitors expressed their views on the subject of dentition, as indicative of the age, in the agricultural press.

Mr. James Howard, M.P., wrote a letter to the 'Agricultural Gazette,' from which the following paragraph is quoted:

"According to my own observation, the dentition varies much according to families, and to a considerable extent in the same family; but in the majority of cases dentition in the same litter is tolerably uniform when three months old; at six months the boars, and particularly the more robust ones, show a marked forwardness; at nine months the dentition is often very varied; at twelve months some of the pigs of the same litter will show a state of dentition from two to three months in advance of others, and also in advance of the condition laid down in Professor Simonds' treatise."

This definite statement of the results of his own observations, by an eminent breeder and exhibitor, was far too important to be passed over without notice. It will be observed that Mr. Howard's remarks had reference to the most critical ages, viz. six months, nine months, and twelve months; and I, perhaps not unreasonably, indulged a hope that I might obtain an exact account of the particular variations which had been noted at the ages named; I therefore wrote to Mr. Howard for the information. In reply, Mr. Howard enclosed a memorandum from his farm manager, expressing, at the same time, his regret that "he did not take notes," adding that the farm manager "is a most reliable and truthful man."

The memorandum from the farm manager is as follows :—

"BRITANNIA FARMS, BEDFORD, *March* 1, 1882.

"The subject of dentition as indicating the ages of pigs was first brought under my notice when a pen of your pigs were disqualified at Birmingham Show, some years ago; and to prove for my own private satisfaction whether it could be relied on, I from time to time examined litters then in my possession. I should think my examinations extended for about three years, and, I know, proved conclusively to my mind that no reliance can be placed on the dentition of a litter as a true test of the age. I kept no account or notes of my examinations, not at that time thinking it would come to such prominence as at the present time. The results were as given by you in a former letter, from which the enclosed paragraph is taken."

The "enclosed paragraph" referred to was the paragraph (quoted above) from Mr. Howard's letter to the 'Agricultural Gazette.'

Another inquiry, which was instituted about the same time as the above, ended in an equally unsatisfactory manner.

Mr. Sanders Spencer informed me that he had in his possession a pig of one year old which had the lateral permanent incisors. As such an abnormal state of dentition had not been seen before, an opportunity was sought to inspect this dental phenomenon. Unfortunately the application was made too late. Mr. Spencer wrote in response :—

"HOLYWELL MANOR, ST. IVES, HUNTS, *February* 6, 1882.

"The yelt I mentioned to you on Thursday failed to breed, so she was sold to our village butcher, to whom I will to-day apply and try to obtain from him, or the purchaser, the lower jaws of the pig, and will forward them to you if they are not damaged, as they usually are, by the butcher when chopping off the snout. I believe I did not mention to you the circumstance that one of the yelt's central incisors (temporary) was broken off, so that the abnormal dentition may have been caused by accident."

The promised specimen was not obtained; but, in reply to another letter of inquiry, Mr. Spencer wrote as follows :—

"After finding the yelt had cut her permanent lateral incisors, I examined her molars, but found nothing unusual in their development. Nos. 1 and 2 were much worn, and seemed quite ready to move for the permanent ones. No. 5 looked very white, but was apparently fully grown."

It appears from the above remarks that the state of dentition in respect of the molar teeth was exactly what it is expected to be at the age of one year, while the incisors indicated the animal to be six months older. That such a specimen was lost must remain a subject of regret.

It is not intended in anything which has been stated to question the fact of the occurrence of irregularities in the dentition of the animals of the farm. On the contrary, my subsequent remarks will contain references to numerous and

remarkable exceptions to the rule of development of the teeth of different animals. It is, however, contended that the expert is perfectly familiar with the exceptions, and knows exactly how to make allowance for them in forming his opinion of an animal's age. Any one of common intelligence can become an expert in judging the age by the teeth, if he chooses to devote some years to the patient and critical study of the subject; but until he has thus qualified himself he ought not to assume the right to criticise opinions based on evidence which he cannot appreciate. The events of the last exhibition of the Society at Reading, without referring to similar cases, which have been sufficiently numerous in past years, suffice to prove that what ought to be the unquestionable evidence of a breeder's certificate cannot always be accepted without hesitation. At the last Show eight pens of pigs were absolutely disqualified, and exhibitors were cautioned in respect of the pigs in seven other pens. Pigs which were shown under the condition that they should not exceed two months had the dentition of three months and six months respectively. Pigs shown under six months had the one-year-old teeth well up, and others in the same class had the dentition of eight and nine months. One man was seen to move a pig, after the inspection was finished, from an old class into a younger one. The attempt to secure for the animal a better position than it was entitled to really led to its disqualification—a consequence which, however unpleasant for the exhibitor, is not the most serious outcome of the attempted fraud; such proceedings as those which have been referred to naturally tend to excite universal suspicion, which may often fall unjustly and without sufficient reason.

In one sense it may be considered satisfactory that, from the first, disqualifications have been recorded chiefly in respect of the pigs of a few exhibitors, who year after year, in spite of warning, persisted in trying how far they might presume on the forbearance of the inspectors, urging, in reply to all remonstrances, that it would not answer for one or two to "show straight," unless they all agreed to do so.

The great majority of exhibitors during the last twenty years have not given any grounds of complaint; and in many instances, notably among the pigs exhibited by Her Majesty, by the Royal Agricultural College, and by Messrs. Howard, the development of the teeth has been rather below than in advance of the rules which have been laid down as the result of long experience. Altogether the evidence of more than a quarter of a century justifies the statement that the evidence of age which is afforded by the teeth, without being absolutely irrefragable, is the most reliable, under all the circumstances, which can be obtained.

The Teeth of the Horse.

Among the animals of the farm, the horse has always occupied a prominent position, and everything relating to his management in health and disease has received special attention. It is not therefore remarkable that horsemen were familiar with the method of judging the animal's age by the teeth long before it was ascertained that a similar method was applicable to other farm-stock. And at the present time, although the investigations which have been carried out by veterinary authorities on the Continent and in this country have led to the collection of a large amount of valuable evidence in reference to the development of the teeth of the ox, sheep, and pig, the fact must be admitted that the teeth of the horse exhibit reliable indications of the age for a much longer period than those of any other animal.

The ages of cattle, sheep, and swine are to be judged with accuracy only during the period occuped by the cutting of the temporary teeth and their replacement by permanent organs; but a peculiar conformation of the teeth of the horse enables the expert to form an opinion of the animal's age long after the completion of permanent dentition. Girard carries his description of the changes which occur in the form of the tables of the incisor teeth, or more properly the nippers, up to the age of twenty years, but very few observers of the present day would venture to assert whether a horse were sixteen or twenty years old; and for practical purposes it is not necessary to pursue the inquiry beyond the age of twelve or fourteen years.

When dentition is completed, the horse has six incisors or nippers in the front of the mouth in both upper and lower jaws, and twenty-four molars, six on each side, in the jaw.

In the male there are also four tusks, one on each side of the upper and lower jaws, between the corner incisors and the molar teeth. Small conical teeth, known as wolves' teeth, appear in many instances in front of the first upper molars in the colt, and sometimes remain after the temporary are exchanged for permanent teeth; but as merely rudimentary organs, they will not require any notice beyond the statement that a vulgar prejudice has assigned to them a special significance as a cause of blindness, and on this ground they are often punched out. If this operation is roughly done, it is a mere act of cruelty. In any case it is superfluous. But, so far as the teeth are concerned, their retention or removal is a matter of indifference.

It is customary in regard to the horse, as to other animals of the farm, to judge the age by the incisor teeth, for the probable reason that they are more easily examined. The amateur may

be content to form an opinion from the mere cursory inspection of the signs which are most readily observed; but the professional examiner is expected to take advantage of all the evidence which he can obtain by a critical inspection of molars and incisors, and he is further required to realise the undoubted fact that in some animals at certain periods of dentition the molar teeth afford more certain indications of age than the incisors.

As this paper aims at dealing with a purely practical question in a perfectly simple and practical manner, it is not intended to touch upon the structure and development of teeth, in fact such a proceeding is rendered unnecessary by the exhaustive remarks with which Professor Simonds introduced the subject of dentition in his lecture, which was published in the 'Journal of the Royal Agricultural Society' in 1854. It is, however, necessary to refer to the peculiar conformation of the incisor teeth, which differ in several important particulars from those of the other animals of the farm.

In the figure (No. 1) the temporary and permanent incisors

Fig. 1.—*Permanent and Temporary Incisors of Horse.*

A. Permanent.

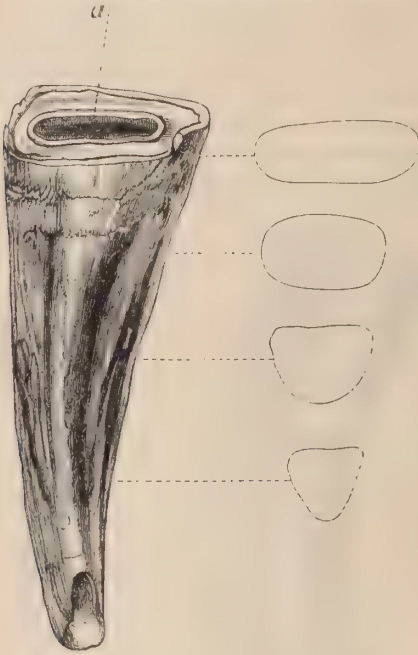
B. Temporary.

are depicted side by side of the natural size, and in each the following parts may be distinguished. First, the crown of the tooth, which projects above the gum; the neck, which is encircled by the gum; and the fang, which is lodged in its appropriate socket in the jaw.

It will be observed that the temporary tooth is much smaller than the permanent organ, which is placed on the left hand, and also that the distinction between the upper part of the tooth or crown and the fang is much more marked in the milk-tooth. In fact the permanent incisor does not indicate any actual line of separation between the upper and lower portions. Both figures are full size.

The next illustration (Fig. 2) shows a perfectly formed central permanent incisor. All the parts of the tooth which the expert is required to note carefully are clearly defined in this figure.

Fig. 2.—*Permanent Incisors* (*Horse*).



In the first place attention is directed to the upper surface of the crown of the incisor, which is described as the table of the tooth. In the centre of the table is a cavity (*a*), familiarly known as the "mark," on account of the dark colour of its interior.

In form, the table of the recent tooth may be described as an elliptical figure, with its long axis running transversely. At the end of the fang the figure is also elliptical, but the long axis is exactly at right angles to that of the table; and by grinding, or by the slower process of wearing an incisor tooth from the upper surface towards the fang, a series of figures will be formed,

passing from the elliptical, to the oval, the square, and the triangle, first with equal sides, and then with two sides longer than the base.

For the purpose of making the nature of these changes evident, the outlines of the figures, which result from the wear of the tooth-structures, are placed on the right of the tooth (Fig. 2). There are, however, other points which require to be noticed. The cavity in the centre of the table is formed by an inflexion of the structures of the tooth in the shape of a hollow cone, the apex of which reaches into the fang. In the recent tooth the cavity extends quite across the table, but, necessarily, as the tooth is worn it becomes more and more circumscribed, and at length the apex of the hollow cone is reached, and the "mark" consists of a mere spec, and then is entirely obliterated.

Owing to the inflexion of the whole of the tooth-structures to form the hollow cone, the tables of the incisors have, besides the ivory and crusta, two distinct rings of enamel, which are distinguished from the other parts by their pearly whiteness, an external or larger ring which forms the outline of the table, and a central ring which surrounds the cavity in the centre of the table. That part of the tooth which is situated in the front of the mark is described as the anterior edge, and the portion behind it as the posterior edge.

All these parts are indicated in the diagram (Fig. 2), and it is necessary that the reader should clearly recognise them, in order to understand the description of the changes which are occasioned by the wear to which the teeth are subjected.

While the temporary dentition is proceeding, and also during the time that the permanent are taking the places of the temporary teeth, the examiner may form an opinion of the age by merely noting what teeth are in the mouth; but when these changes are completed, he is compelled to base his conclusion upon the evidence which he gains from an inspection of the tables of the incisor teeth; those of the lower jaws being always selected. In doing this, he has to observe whether the cavity or mark extends across the tooth, or is surrounded by a line of worn structure, in which case the table is said to be fully formed, as it appears in Fig. 2. The width of the worn surface in front of the cavity, as compared with that at the back, will be taken into consideration, and also the shape of the table, whether oval, or approaching the square, or triangular.

No particular importance can be attached to the tusks as a means of judging the age, they only occur in the horse, and are less regular than the other teeth in the time of their eruption. The small rudimentary teeth which sometimes exist in the place of tusks in the mare must not be taken into account at all.

There may in certain cases be reason to suspect that the mouth

of the horse under examination has been manipulated, with the view to make the animal appear younger or older than it really is. Up to the age of five years it may be advantageous to the seller to convince the purchaser that the horse is above its real age; but as six years old is, according to general conviction, the period of equine perfection, an old horse gains by being made to appear as near that age as possible.

That the horse's mouth is sometimes subjected to certain processes for the purpose of deception cannot be doubted. Many young animals come into the market bearing evidence in the malposition of their teeth, or in the absence of some of them altogether, that violence has been employed to anticipate the natural process of eruption, but often in so bungling a manner that the object has been defeated. Early extraction of the temporary teeth facilitates the cutting of the permanent organs, and by commencing with the central incisors as soon as signs of their displacement are seen, and continuing the same system in respect of the lateral and corner teeth, the whole of the permanent incisors may be brought into the mouth soon after four years. The cutting of the tusks at this age is also facilitated by fitting a hot iron, cunningly arranged, over the points of the teeth which may be just pricking through the gum, and thus burning away the structure which would naturally almost obscure the organs from view.

Treated in the manner above described, the horse at four years off is accepted as coming five years old; but the expert is well aware that at the age of four years there are eight molar teeth which have only just approached the level of the others, and these enable him to distinguish with absolute certainty between a horse of four and another of five years old.

The clumsy expedient of excavating the centres of the teeth of old horses, and blackening the cavity thus made by means of a hot iron to represent the lost mark, is not likely to deceive any one who is familiar with the anatomy of the teeth, and the operation, which is dignified by the term "Bishoping," from the name of its inventor, is too laborious to be often performed; indeed, it may be allowed that the tricks which are played with horses' mouths are not so frequent, or so successful, as to constitute an important element in the question of the value of the evidence of age which is afforded by the teeth.

It is customary to calculate the ages of all thoroughbreds up to January 1, and of other horses to May 1. The terms "off" and "coming" are employed with the understanding that they mean the addition to or subtraction from the stated age of a few months. Thus "three years off" is allowed to mean three years and about three months; and "coming four years," means that

the horse wants about three months to complete the year. It is not essential that the examiner should conform to usage in respect of the terms above mentioned, unless he thinks fit to accept them, nor is he compelled to insist that the year shall be completed in all cases on the first of January or May. Where accuracy is required, the statement of the opinion of a horse's age will be made absolutely, and without any reference to an arbitrary standard, which nevertheless may, for ordinary purposes, have a certain amount of convenience.

In reference to horses which are entered at a certain age at an Agricultural Exhibition, a question has more than once arisen as to the precise meaning or intention of the terms applying to the class, and the question has not yet been answered in a satisfactory manner. For example, an animal in the four-year-old class, in which a certificate of the year of birth only is required, has a condition of dentition which indicates that he is nearly five years old. This may be admitted by the exhibitor, but he also contends that the horse is a four-year-old until he has reached his fifth birthday. If this plea be allowed, it is obvious that a horse foaled in the beginning of the year may have to compete with one which was foaled late in the same year. It may, however, be suggested that the statement of the day of birth will at once dispose of this difficulty.

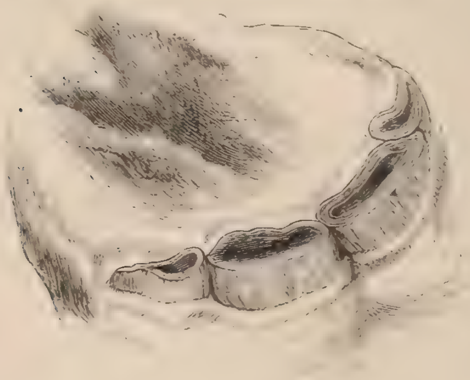
Evidence of the Age of the Horse during Temporary and Permanent Dentition.

At birth the foal has the two central temporary incisors somewhat laterally placed, in consequence of the jaw not being wide enough to accommodate them both in front. The teeth are nearly covered with the gum, and only a small portion of the upper anterior edge is to be seen free from the membrane. In some cases the extreme corners of the lateral incisors are to be detected in outline under the gum. The three temporary molars are usually entirely covered with gum at the time of birth. This state of the mouth is shown in the next drawing (Fig. 3, p. 396), which was taken, on the morning of its birth, from a cart colt foaled at the Royal Agricultural College Farm.

By the end of the second week after birth, the central incisors will be fairly in the mouth, and in six or eight weeks the lateral teeth, and also the temporary molars, are well up. In the illustration (Fig. 4, p. 396) the state of the incisor teeth at two months old is shown. The central incisors at this age have the surfaces very slightly worn, and the cavity or infundibulum is not surrounded by a line of worn structure; only the anterior edges of the teeth have yet been subject to attrition. In the

Fig. 3.—*Incisors of Colt at birth.*

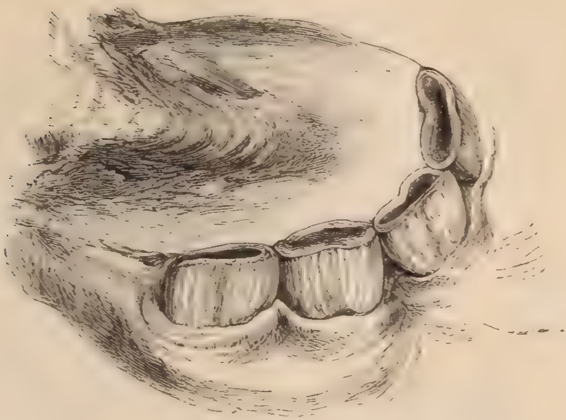
Fig. 4.—*Incisors of Colt at two months.*



lateral incisors the wear is confined to a small portion of the anterior edge which is nearest to the central teeth. These appearances are indicated in the drawing (Fig. 4).

Between two and six months old the central and lateral incisors increase in size with the growth of the animal. At six months old the mouth has a very neat and compact appearance. The centrals and laterals are well developed, and their anterior edges are worn level. The posterior edges are, however, still rather below the anterior, and the table, therefore, is not perfectly formed. The next drawing (Fig. 5) was taken from the mouth of a cart-colt at the age of six months.

Fig. 5.—*Incisors of Colt at six months.*



Soon after seven months, indications of the cutting of the corner teeth may often be seen, and in many instances the points of the teeth will be observed pricking through the gum. At nine months old the colt will have the corner incisors in the mouth with their extreme anterior edges in apposition, leaving a triangular space, which is seen most perfectly on a side view when the lips are slightly separated.

At this period the fourth molar, which is a permanent tooth from the first, begins to protrude through the gum, and by the time of the completion of the first year it is level with the temporary molars; but its surface is not worn, and the recent appearance of the tooth is most important as evidence of the age of one year.

The illustration (Fig. 6, p. 398) shows the condition of the molar teeth at the completion of the first year. Three temporary molars have the upper surface worn, and are thus readily distinguished from the fourth molar, which has only recently been cut.

The next illustration (Fig. 7, p. 399) shows the shell-like character of the corner teeth, and the state of the tables of the other incisors in the one-year-old colt; and it may be remarked that the appearances correspond with those of the teeth of the five-year-old horse; the chief difference being that in the yearling the teeth are temporary, and in the five-year-old permanent, organs.

A practical horseman would perhaps feel amused at the idea of the possibility of a yearling being taken for a five-year-old, or a two-year-old for a six; but in the case of rough forest-ponies, in which the aspect of colthood is quickly lost, such

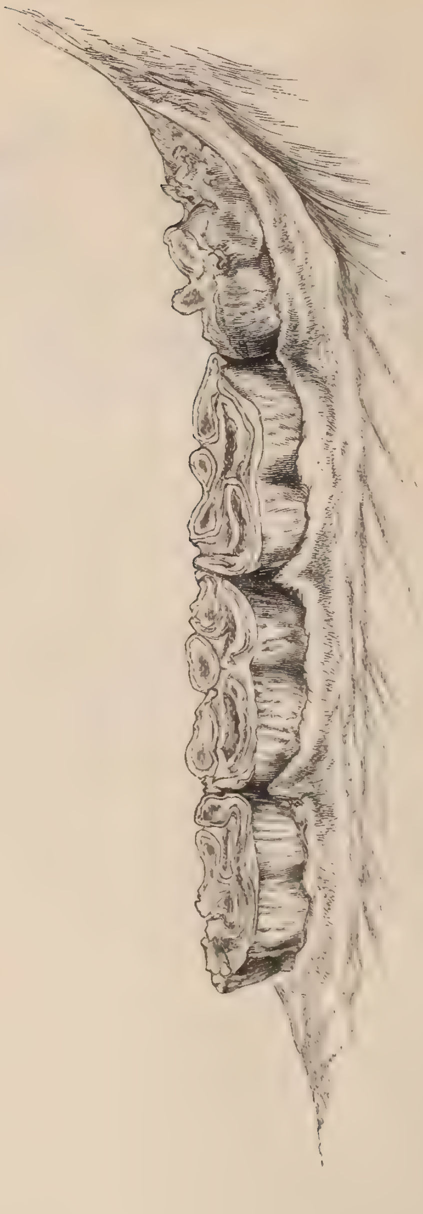
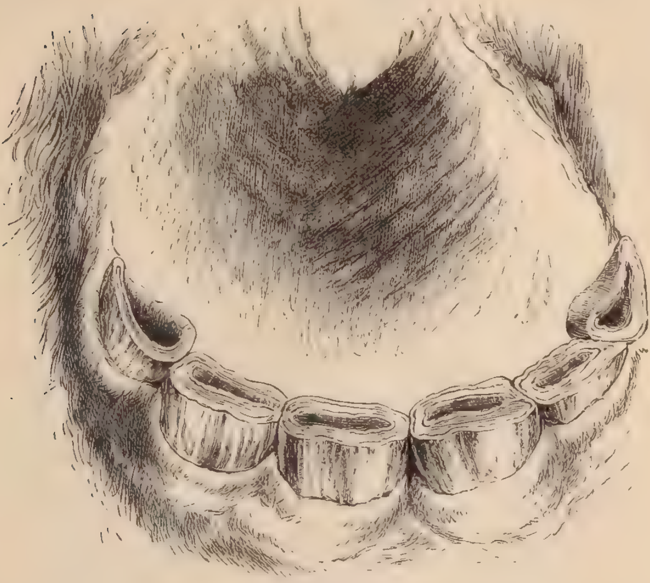


Fig. 6.—*Molar Teeth of Colt at one year.*

Fig. 7.—*Incisors of Colt at one year.*



mistakes have occurred; and it is therefore not out of place to suggest that care should be taken to discriminate between the temporary incisors, and, if necessary, to refer to the molar teeth, in order to avoid such embarrassing blunders.

Under ordinary circumstances it will be more frequently necessary to distinguish between a yearling and a two-year-old, than between one-year old and five, and it fortunately happens that at the age of two years another molar, the fifth in situation, is in the mouth, and may be at once distinguished by its recent appearance. Soon after eighteen months the fifth molar begins to protrude through the gum, and by the termination of the second year is level with the other molars, as shown in Fig. 8, p. 400, so that any doubt which may remain after an inspection of the incisors may be settled by reference to the condition of the molars.

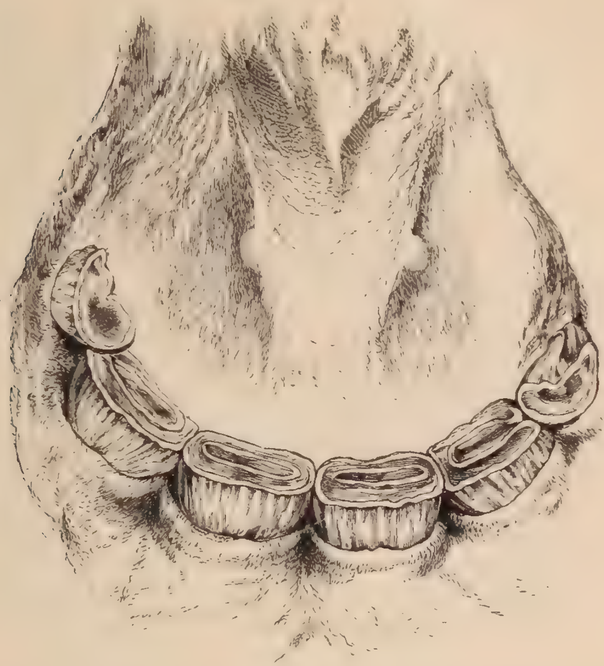
It will be observed in the figure just referred to that the surfaces of four molars are worn level, while the points of the new tooth, the fifth in position, are rounded, excepting a small portion at the inner side of the tooth, which shows the effects of attrition, but only to a slight extent.

The incisor teeth at two years of age have their tables perfectly formed as a rule; but, in some instances, the corner teeth, although they have lost their shell-like character, still

Fig. 8.—Molars of Colt at two years.

have a portion of the posterior edge untouched, as shown in the following illustration of the mouth of a two-year-old filly.

Fig. 9.—*Incisors of Cart-filly at two years.*



Between two and three years of age the central temporary incisors of the horse are changed for permanent teeth, and the different phases of the change are sufficiently well defined to assist the examiner in deciding whether the animal is two years off or coming three years.

At two years off, or two years and a quarter, there will be evident signs of the shedding of the upper central incisors. The gum at the necks of the teeth is somewhat sunken, and the colour is rather deeper than in other parts. Very soon a red line appears in this position, and it is evident that one or both of the temporary teeth are only held in their places by a small portion of the fang which has not yet been absorbed. At two years and a half the permanent teeth will generally be in the mouth. Perhaps one temporary central incisor may yet remain; but even in that case the state of the permanent teeth will be sufficient evidence of the animal's age.

The mouth of the horse at two years and a half has a very characteristic appearance, especially when viewed in the front, by separating the lips. The four permanent central incisors are seen in position about half grown, with deep cavities or infundibula extending across each tooth, presenting a striking contrast to the worn temporary teeth on each side of them. The new permanent teeth at this age are not more than halfway up, and there is consequently a considerable space between the upper and lower teeth when the temporary teeth are in apposition.

When the horse has reached the age of two years and nine months, the four permanent incisors will be in actual contact, at least in regard to their anterior edges when the mouth is closed ; but, on examining the tables, it is apparent that no wear has taken place, and the posterior edges of the teeth are not yet level with the anterior.

At three years old the central permanent incisors are fully developed, and the anterior edges show a narrow line of worn surface. The posterior edges are level with the anterior, but are not worn to the same extent.

These appearances are shown in the next illustration (Fig. 10), which was taken from the mouth of a colt at the completion of the third year.

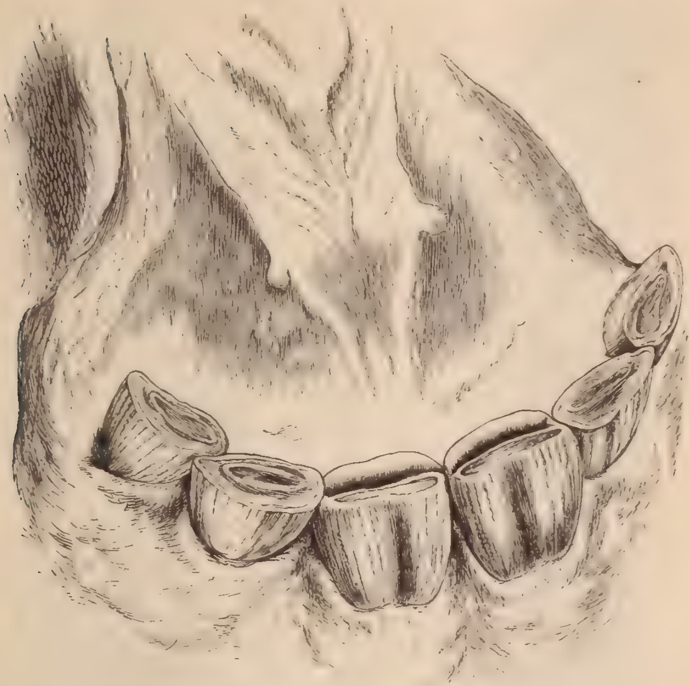
During the development of the central permanent incisors in the course of the third year, an important change is going on in the first and second molars, the fangs of which are gradually absorbed as the permanent teeth push their way up underneath them.

At two years and a half old, one or two of the permanent molars may be in the mouth. Sometimes the second in position is cut before the first, and a careful examination will show that the crowns of the first and second temporary molars which yet remain are only retained in their position by a slight attachment to the gum, and very little force is required to dislodge them.

The succeeding drawing (Fig. 11, p. 404) shows the condition of the molar teeth soon after two years and a half. A permanent tooth, the first in position, is seen occupying the place of the temporary molar which has fallen, and the second permanent tooth is pushing its way up under the second temporary molar, which is only held in its place by small portions of the fangs which have not yet been absorbed. The fifth molar, which was up at two years old, is fully developed, and is quite clear from the angle of the jaw.

At three years old the first and second permanent molars are well up, and the top and bottom teeth are in contact when the

Fig. 10.—*Incisors of Horse at three years.*



mouth is closed; but the teeth are distinguished by the recent appearance which they present in comparison with the worn surfaces of the teeth immediately behind them.

From the completion of the third year to the termination of the fourth year, the changes which have been described in reference to the central incisors and the first and second molars occur in the lateral incisors, and the third and sixth molar.

At three years off the same condition of the gum which was described in respect of the upper central temporary incisors, now appears at the necks of the lower lateral temporary incisors. At three years and a half some or perhaps all four of the permanent lateral incisors are in the mouth; and soon afterwards the fourth and sixth permanent molars are cut, as shown in the drawing (Fig. 12, p. 404).

No difficulty would be experienced in distinguishing the recent molars in the condition represented in the illustration. The first and second, and the fourth and fifth molars show considerable wear, while the new teeth present rounded points on

Fig. 11.—*Molars of Horse at two years and seven months.*

Fig. 12.—*Molars of Horse at three years and eight months.*

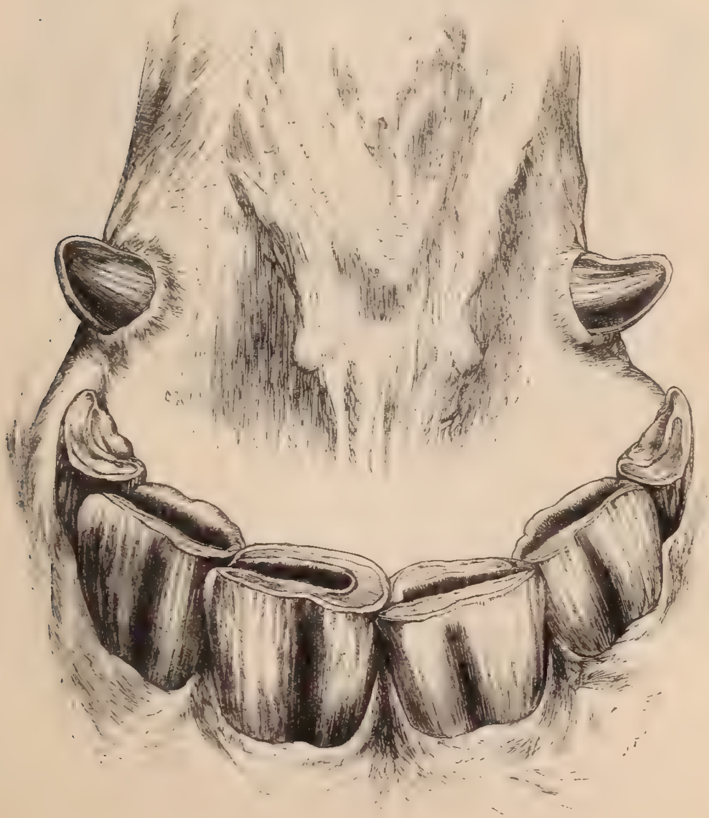
their surfaces, and are not nearly level with the other teeth. One or two of the most projecting points of the sixth molars show the effects of attrition; but these teeth at the age of three years and a half have their posterior points close to the angle of the jaw and still covered with the gum.

At four years old the horse has the lateral permanent incisors in apposition, and the fourth and sixth molars are level, or nearly level, with the other teeth.

The tusks of the horse are often through the gums at four years of age, but they are not usually fully developed before five years, and occasionally they are not well up before five years and a half. As a means of judging the age, these teeth are of little importance.

The following drawing (Fig. 13) represents the state of the incisor teeth on the completion of the fourth year.

Fig. 13.—*Incisors of Horse at four years.*



Remarkably well-developed tusks were an exceptional feature in the mouth of the animal from which the above illustration was taken, in other respects the teeth present the appearances which are ordinarily observed at the age of four years. The only milk-teeth now remaining are the four corner incisors, which are much worn and quite different from the broad permanent teeth, with which they are not likely to be confounded. In the lateral incisors the wear has affected the anterior edge of the tooth, and the cavity extends completely across the table, which is not therefore fully formed. In the central incisors there is a line of worn surface quite round the central cavity, and the table may be properly described as fully formed.

Incidentally it may be remarked that between the commencement and completion of the fourth year the dental changes include the cutting of four permanent incisors, two in each four tusks, and eight molars—two on each side of both jaws, making sixteen teeth, which are all advancing at the same time.

Between four years and five, the corner temporary incisors are removed, and the permanent teeth occupy their places. Indications of the change are seen at four years off in the upper corner incisors, and in a few months the temporary teeth are displaced, and the permanent organs are in the mouth, but their edges do not meet until the fifth year is completed, and even then the contact is limited to the anterior part, and a triangular space, similar to that which can be seen between the upper and lower corner teeth in the mouth of the yearling, may be recognised when the lips are separated at the side of the mouth. The shell-like character of the corner permanent teeth is the special indication of five years old.

In the next figure (Fig. 14) the condition of the incisors in the five-year-old mouth is shown.

In the illustration it is evident that the corner permanent incisors show but slight indications of wear on the completion of the fifth year, only the anterior edge exhibiting the effects of attrition. The tables of the lateral incisors are fully formed by the central cavity being surrounded by a line of worn surface. In the central incisors the cavity has become extremely shallow.

With the development of the permanent incisors the permanent dentition of the horse is completed.

Fig. 14.—*Incisors of Horse at five years.*

Indications of Age of the Horse afforded by the Teeth after the completion of Permanent Dentition.

From the completion of permanent dentition, the evidence of age is to be obtained by the inspection of the tables of the incisor teeth, in regard to their form, the extent and depth of the central cavity, and the shape of the central enamel.

At six years old the horse's age is judged chiefly by the amount of wear which the corner teeth have sustained, although there are other marks which are worthy of notice.

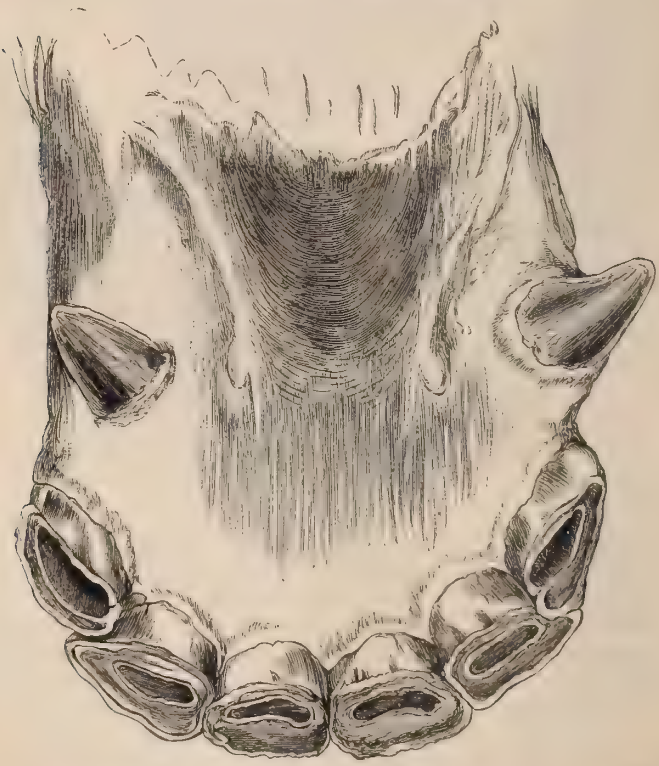
The corner teeth have lost their shell-like character, and a

line of worn surface surrounds the central cavity, excepting a small point where the corners touch the lateral incisors. The line of wear is broader at the anterior than at the posterior edge, and the cavity is still of considerable depth.

In the lateral incisors the cavity (or mark) is shallow, and much smaller than that of the corner incisors. The figure described by the central enamel is approaching an oval. The cavity in the central incisor is almost worn out, but its boundaries are distinctly marked by the central enamel which surrounds it, forming an elliptical figure which extends almost across the tooth in the direction of its long diameter, and is nearer to the posterior than to the anterior edge.

The tusks are usually well developed, but their points are not worn, and the hollows on their inner surfaces are well defined.

Fig. 15.—*Incisors of Horse at six years.*

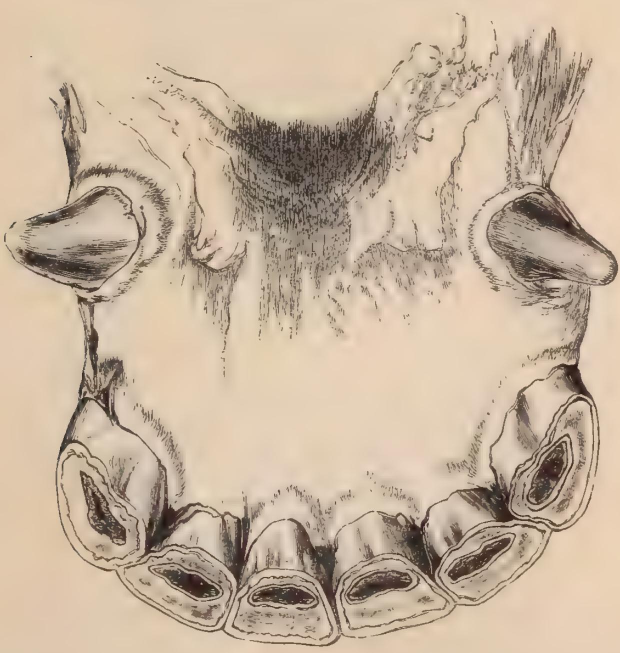


All the above characters are shown in the illustration (Fig. 15) of the lower incisors of a six-year-old horse.

At seven years old the tables of the corner teeth are perfectly formed, and the cavity in each tooth is very shallow. The central enamel, however, is well defined and forms an elliptical figure, which is nearer to the posterior than to the anterior edge of the tooth. In the lateral incisors the central enamel forms a figure which is nearer to the oval than to the elliptical, and the mark, which is very shallow, does not extend so far across the table of the tooth as it does at six years old. These teeth are also deeper from front to back than they were at six years.

The central incisors at seven years old have their sides elongated, so that the table approaches the figure of a triangle. The mark is very close to the posterior edge of the tooth, and the central enamel forms an oval with flattened sides in place of the elliptical figure, which is shown in the drawing of the six-year-old mouth. The tusks are somewhat blunted at their points.

Fig. 16.—*Incisors of Horse at seven years.*

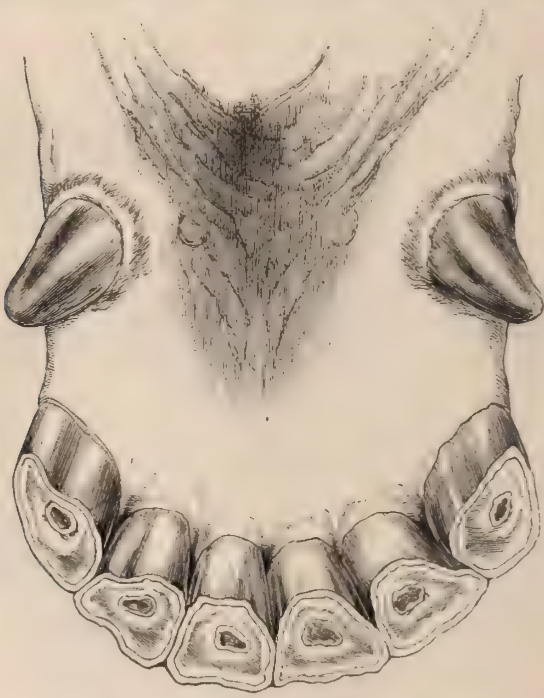


The illustration (Fig. 16) represents the above described characters of the seven-year-old mouth.

In the eight-year-old mouth the form of the tables of the incisors and the shape of the central enamel in the central incisor afford tolerably satisfactory indications of the age. The central teeth are more distinctly triangular than they were at seven years; the central enamel in these teeth is also triangular in figure. All the tables of the incisors are worn as level as the different degrees of density of the various structures will permit. The cavities are either very shallow or quite obliterated by being filled up with one of the tooth tissues, although the central enamel in each tooth is perfectly well defined. The gum of the corner incisors at eight years has lost its circular form and become square. The tusks are more blunted at the tops than in the seven-year-old mouth.

In the next illustration (Fig. 17) the appearance of the eight-

Fig. 17.—*Incisors of Horse, ("Peep-o'-day-Boy,") at eight years.*



year-old mouth is shown. The drawing was copied from the mouth of "Peep-o'-day-Boy" in 1852. The horse was foaled in 1844.

From eight to ten years old the changes occasioned by the wear to which the teeth have been subjected are not sufficiently regular to enable the examiner to speak positively as to the exact age, but during this period the cavity in each lower central incisor is worn out, and only a small circle of enamel in the tables of the central incisors remains to indicate its position. In the corner teeth at ten years old the central enamel has become round, or nearly so, as shown in the accompanying drawing (Fig. 18) of the mouth of "Solace," a steeplechase mare, foaled in 1842. The teeth are depicted exactly as they appeared in the summer of 1852, and fairly represent the characters of the ten-year-old mouth.

Fig. 18.—*Incisors of Horse,* ("*Solace,*") *at ten years.*

At twelve years old the teeth are longer from the receding of the gums, and are also narrower in consequence of having been worn towards the fang, which decreases in width from the neck of the tooth to its termination. The tusks are blunted, especially those of the upper jaw, and a quantity of tartar often surrounds those in the lower jaw. The incisors at this

age project almost in a straight line from the jaws, and in some mouths a line drawn transversely across the tables of the teeth will cut the centres of all of them, excepting those of the corner teeth.

The next drawing (Fig. 19) represents the teeth of the thoroughbred horse "Lothario," foaled in 1840, as they appeared in 1852.

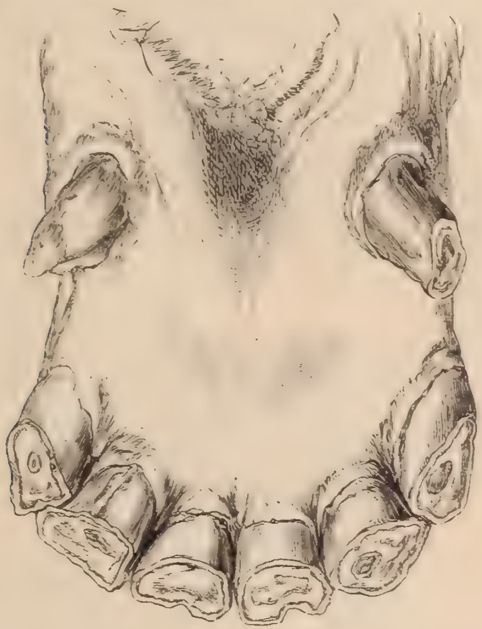
Fig. 19.—*Incisors of Horse, ("Lothario,") at twelve.*

On comparing the tables of the teeth with those of the mare "Solace" (Fig. 18) at the age of ten years, it will be seen that there are certain important differences. The central incisors have quite lost the "mark," which is only represented by a dot. The central enamel in the remaining incisors forms a much smaller figure than in the ten-year-old teeth. The corner teeth have become more oval in form, and only a trace of the central enamel can be seen.

After twelve or fourteen years of age, the evidence which is afforded by the teeth is not definite enough to justify a positive opinion as to the animal's age, and the two next illustrations (Figs. 20, 21), which are accurate representations of the teeth

of the thoroughbreds "Kremlin" and "Epirus," will show how far the appearances may differ in animals of the same age. Both horses were foaled in 1834, and the drawings show the state of the teeth in 1853, when the animals were nineteen years old.

Fig. 20.—*Incisors of Horse, ("Kremlin,") at nineteen.*



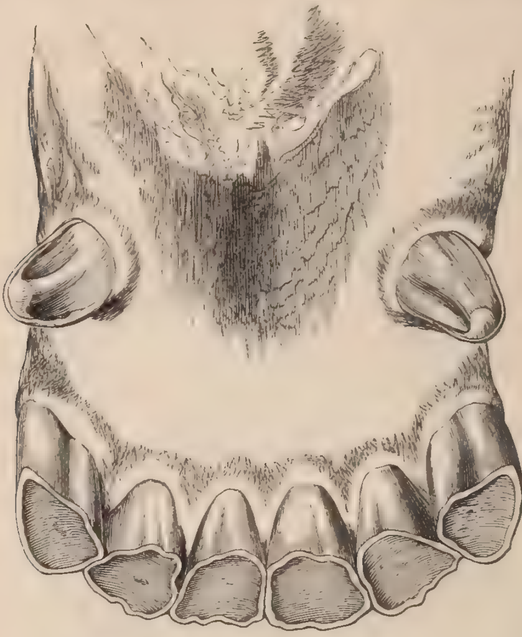
In both cases the teeth form a more acute angle with the jaw than is usual at this age. In this particular both mouths agree, but in other respects they differ from each other to a remarkable extent.

The central enamel can yet be seen in all the incisors of "Epirus" (Fig. 21, p. 414). In fact, the remains of the marks are more evident than they are in the teeth of "Lothario" (Fig. 19) at twelve years of age. The table of the incisors in the mouth of the older animal are triangular instead of square.

"Kremlin" (Fig. 20) shows a comparatively youthful form of the tables of the incisors, a condition which is due to the rectangular position of the teeth in regard to the jaw, but it is evident that the central enamel is entirely worn out, not a trace remaining. The small circles in the tables of the teeth merely indicate the apex of the inverted cone in which the

infundibulum originally existed, and any good observer looking at the two mouths would decide that "Kremlin" was older than

Fig. 21.—*Incisors of Horse, ("Epirus,") at nineteen.*



"Epirus." It is, however, quite certain that both horses were of the same age, and both of them much older than the teeth indicated them to be.

THE TEETH OF THE OX.

In the front of the mouth of the ox there are eight incisors or cutting teeth in the lower jaw only; an elastic pad of fibrous tissue, covered with mucous membrane, takes the place of teeth in front of the upper jaw. The incisors may be distinguished as centrals, or first-pair; middles, or second-pair; laterals, or third pair; and corners, or fourth pair; the same terms being equally applicable to the temporary and permanent organs.

Temporary incisor teeth are easily distinguished from permanent, chiefly by their size. The fangs of the temporary incisor teeth are much shorter than those of the permanent in-

cisors, but this fact is not to be recognised until the teeth are removed from the jaw. No question is likely to arise in the mind of the examiner as to the distinction between temporary and permanent organs; in fact the common term "broad teeth," as applied to the latter, sufficiently indicates their prominent feature.

Molar teeth are named first, second, or third, according to their position. In the temporary set there are three molars on each side of the upper and lower jaw, and in the adult these teeth are changed for permanent organs; while three additional teeth, the fourth, fifth, and sixth in position, all of which are permanent teeth from the first, are added, making the full set of permanent molar teeth six on each side of the upper and lower jaws.

In the mouth of the calf at birth, the temporary teeth, molars, and incisors, are all so far advanced, that they may be seen in outline under the gum, and commonly the cutting edges of the incisors and a few of the points of the molars are uncovered. The illustration (Fig. 22) shows the state of the incisors at birth.

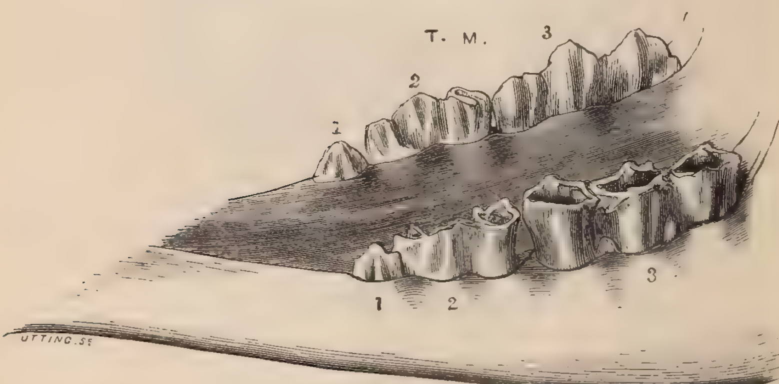
Fig. 22.—*Incisors of Calf at birth.*

The advance of the teeth and the receding of the gums proceed very rapidly after birth, and at the age of one month the temporary teeth, viz. eight incisors in the lower jaw, and three molars on each side in the top and bottom jaws, are fully developed. Figs. 23 and 24 (p. 416), show the temporary incisors and molars in the calf of one month old.

No accurate opinion of the age of a calf can be formed from the observation of the state of the dentition between the ages of one and six months, when the fourth molar is cut; but during this period the jaws expand, the incisor teeth gradually become less crowded, and the space between the third molar and

Fig. 23.—*Incisors of Calf at one month.*

Fig. 24.—*Molars of Calf at one month.*



the angle of the jaw increases as the fourth molar, which is the first permanent tooth, advances to occupy its place, as shown in Fig. 25.

At the age of six months the fourth molar is well developed, but it is in close contact with the angle of the jaw, and the posterior surface is not quite free from the covering of the gum.

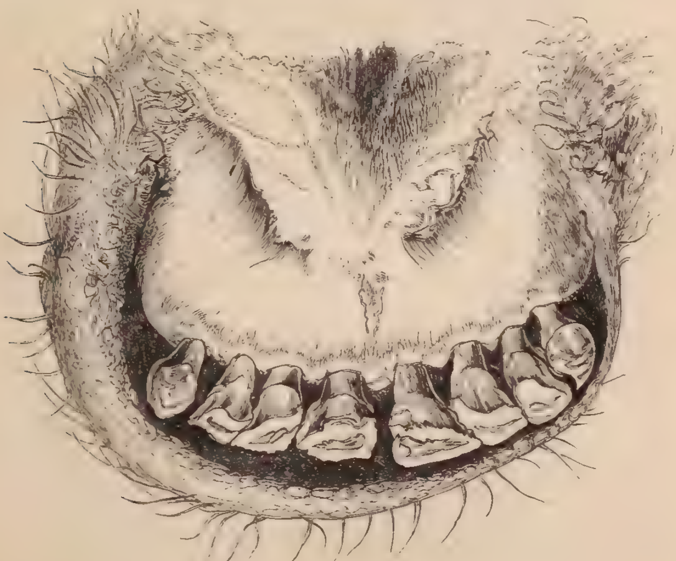
Between six and twelve months old there are no important dental changes, the incisor teeth become worn, and as the jaws increase in size, there is more space left between them; but it

is not possible to assert from the states of the incisor teeth whether an animal is under or over the age of one year.

Fig. 25.—*Molars of Calf at six months.*

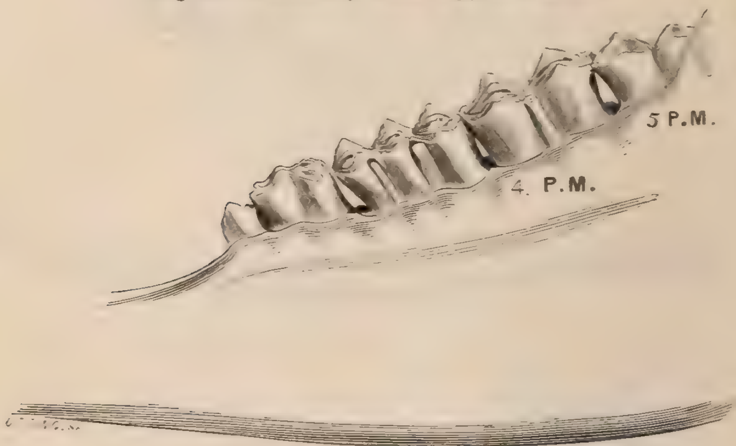
The illustration (Fig. 26) represents the average state of the incisors at the age of one year.

Fig. 26.—*Incisors of Steer at one year.*



Shortly after one year the fifth molar begins to make its appearance, and at fifteen months it is well up. The appearance which the fifth molar presents at this age is very much like that of the fourth molar at the age of six months. The new tooth is in close contact with the angle of the jaw, and the gum covers the extreme posterior part of its surface. These appearances are shown in the illustration (Fig. 27).

Fig. 27.—*Molars of Steer at fifteen months.*



No change occurs in the incisors, excepting that which is caused by the wear of the teeth and the growth of the jaw, until the age of one year and eight or nine months, at which time the two central teeth are loose and the first broad teeth sometimes begin to project through the gum. In very forward animals the central permanent incisors are cut at the age of a year and seven months, but they are never level with the other incisors before one year and ten months, and their perfect development is indicative of the age of two years.

The next illustration, Fig. 28, was taken from a Shorthorn heifer at the age of one year and ten months, and may be accepted as indicative of the general appearance of the incisors at that age.

While the first pair of permanent incisors are advancing to take the place of the temporary teeth, the sixth and last permanent molars push their way through the gum, and at the age of two years are in position. Any error of opinion as to the age which might arise from the premature cutting of the central permanent incisors may be corrected by reference to the state of the molars.

Fig. 28.—*Incisors of Heifer at one year and ten months.*

In the next illustration (Fig. 29, p. 420) the sixth molar is shown in the position described, and in the same figure the first and second permanent molars have taken the places of the temporary teeth; this change, in my own experience, does not usually occur until the animal is a month or two over two years of age.

From two years and three months to two years and six months the second pair of broad teeth, the middle permanent incisors, occupy the place of the corresponding temporary teeth in all the cultivated breeds. Instances of late dentition present themselves from time to time, in which the middle permanent incisors are not cut until the animal is approaching three years old. There is consequently a possible variation of six months in the time of the appearance of these teeth.

In the illustration (Fig. 30, p. 420), the ordinary condition of the incisors at two years and six months is shown.

Fig. 29.—*Showing the Sixth Molar at two years.*

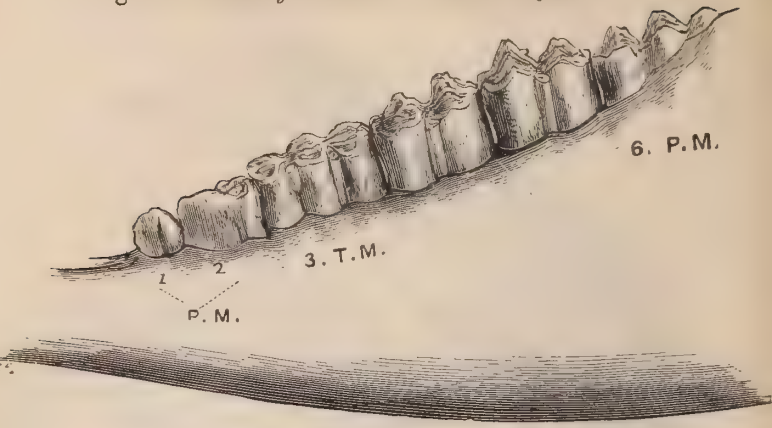
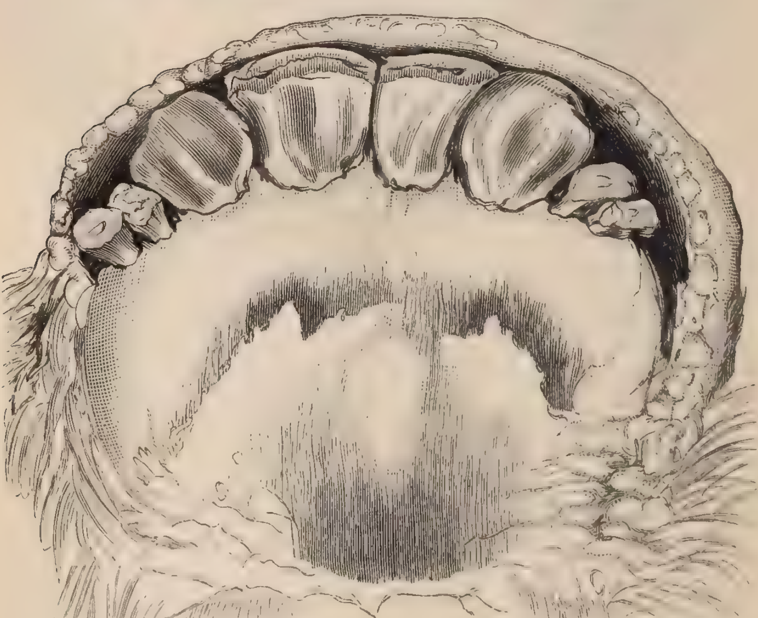


Fig. 30.—*Incisors of Ox at two years and six months.*



It must be understood, in reference to the appearance of the second pair of broad teeth, that an expert, looking at a mouth which corresponds to the drawing, will conclude that the

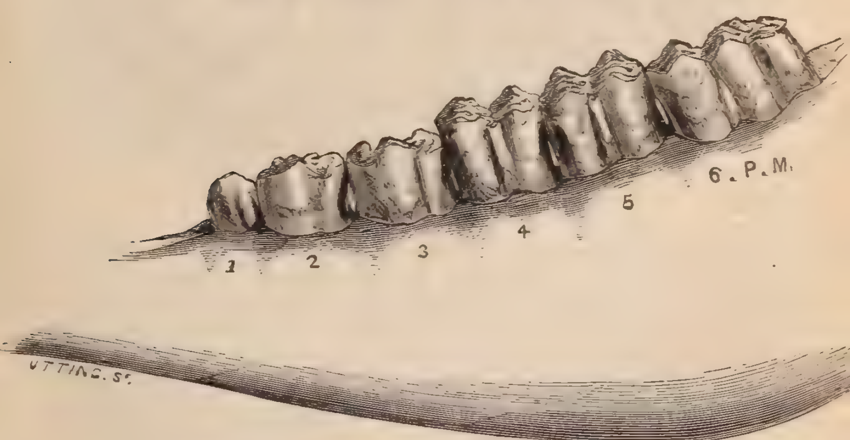
animal is two years and a half old; but if he is required to certify that the age is under or above that period, he must proceed to inspect the molar teeth, and take into account the animal's pedigree, its sex, and its general condition of development.

If the animal in question is a bull of one of the cultivated breeds, and has been forced to a state of early maturity, it may be expected that the second pair of permanent incisors will be cut at two years and four months; and if either of the anterior temporary molars remain in their places, the conclusion that the animal is under two years and a half will be strengthened.

Shortly after the first and second molars are cut, the third makes its appearance; occasionally it appears before the others, and the animal at the age of three years will have the three anterior molars nearly level with the other teeth, but showing no signs of wear.

The following illustration (Fig. 31) exhibits the three recently cut anterior molars as they appear when the ox is verging on three years of age.

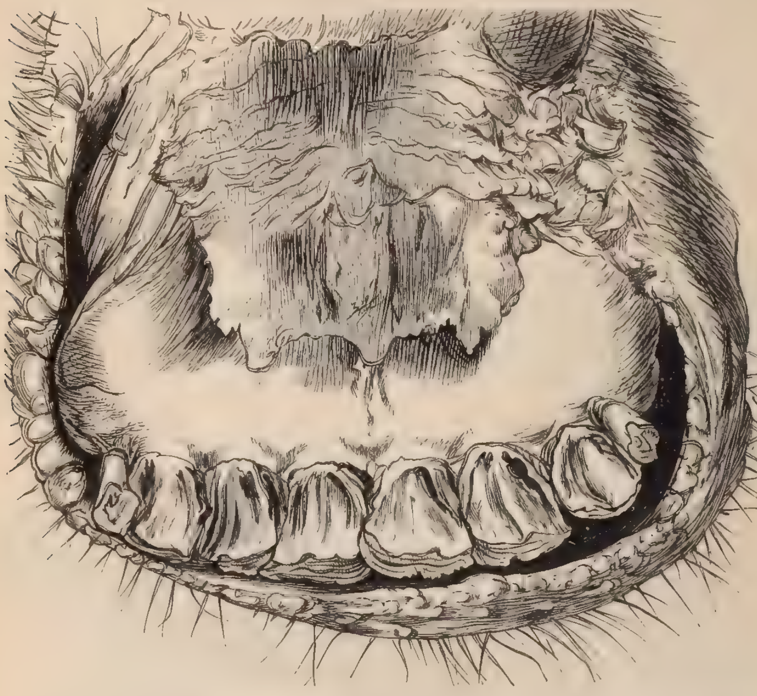
Fig. 31.—*Molars of Ox at three years.*



The eruption of the third pair of permanent incisors may occur at any time between two years and six months and three years of age. In cultivated breeds they are present, as a rule, before the animal is three years old, and occasionally they will be found well developed after two years and a half. In fact, the anterior molars afford more reliable evidence of the age between two and a half and three years old than is furnished by the incisors.

The next illustration (Fig. 32) represents the average condition of the teeth in cultivated breeds at three years of age.

Fig. 32.—*Incisors of Ox at three years.*



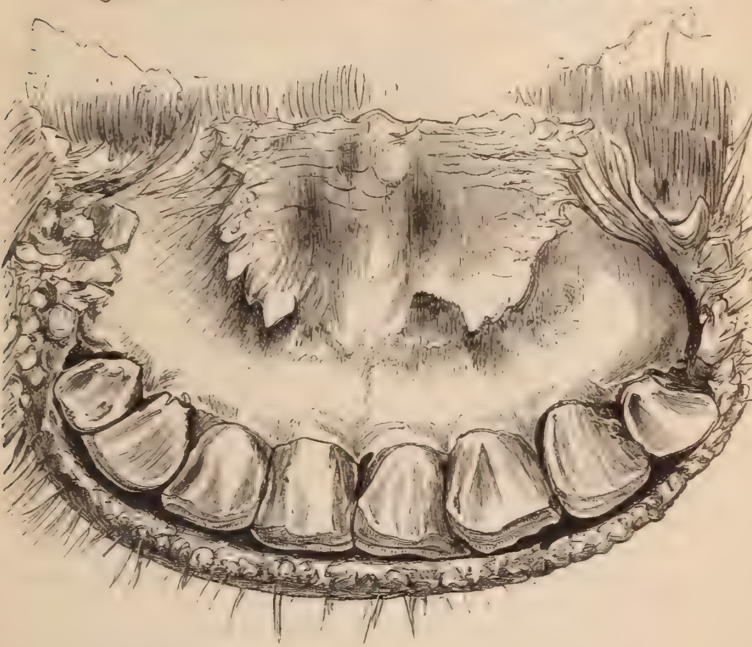
The fourth pair of broad teeth, the corner permanent incisors, are more subject to variation in the time of cutting than the third pair. In well-bred cattle they take the place of the temporary teeth soon after the completion of the third year, but in bulls they are not uncommonly present at two years and ten months old, while in some instances they are not cut until three years and nine months. Very little reliance indeed can be placed on the evidence of the corner incisors, and the examiner is compelled to refer to the molar teeth for the purpose of correcting his opinion.

In the succeeding illustration (Fig. 33), the state of the incisor teeth in forward animals at three years and three months is depicted.

With the eruption of the corner permanent incisors, the fourth pair of broad teeth, the permanent dentition of the ox is completed; and after this period the changes in the form of the teeth which are due to attrition will assist the examiner in

forming an opinion of the age; but no exact estimate can be based on such evidence. The five-year-old ox will show a considerable amount of worn surface in the central, middle, and lateral incisors, and the cutting edge of the corner teeth will be marked by a line of wear; but no one would attempt to

Fig. 33.—*Incisors of Ox at three years and three months.*



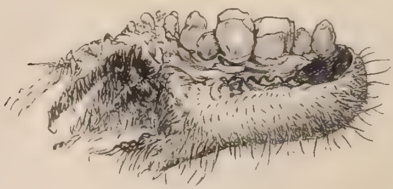
determine whether or not an animal were under or above the age of five, and as the years increase, the difficulty of judging the age by the appearance of the teeth is not diminished. The teeth become narrower and more widely separated from each other year by year, but the changes are not sufficiently well marked to enable the examiner to accept them as reliable evidence of age.

The Teeth of the Sheep.

The terms which are applied to the teeth of the ox for the purpose of description may be used in regard to the teeth of the sheep. Eight incisors, central, lateral, middle, and corner teeth, are found in front of the lower jaw only, the corresponding part of the upper jaw being provided with an elastic pad, as in the

ox. Molar teeth are designated by numbers, to indicate their position, and for the purpose of judging the age. These teeth in the sheep may be described as corresponding to the teeth of the ox in all general points, excepting in regard to their size. At birth, the arrangement of the incisor teeth of the lamb is peculiar, as shown in Fig. 34.

Fig. 34.—*Incisors of Lamb at birth.*



Generally the whole temporary set of teeth may be recognised, but only in outline, as they are nearly covered with the gum. The central incisors are most advanced, and next in order come the laterals, leaving the middle and corner teeth considerably below them. Very often, the cutting edges of the front and third pairs of teeth are through the gum. All these peculiarities are seen in the illustration, which may be accepted as the representation of the ordinary appearance of the teeth of the lamb at birth.

By the end of the fourth week all the temporary teeth are well up, eight incisors; and three molars on each side of the upper and lower jaws.

From the time of the perfect eruption of the temporary teeth at the age of one month, to the cutting of the first pair of broad teeth, central permanent incisors, at the age of one year to fifteen months, the only changes which will guide the expert to a correct opinion of the age are those which affect the molar teeth.

At three months the first permanent molar, the fourth in situation, is cut, and is recognised by its recent appearance in comparison with the tooth immediately in front of it, the third temporary molar, which shows signs of wear.

In the next illustration (Fig. 35), the appearance of the molars at the age of three months is shown.

During a period of five or six months from the cutting of the fourth molar there is nothing to guide the examiner except the growth of the teeth and of the jaw, which results in leaving a space behind the fourth molar. At the age of nine months this space is occupied by the fifth molar, as shown in the drawing (Fig. 36).

Fig. 35.—*Molars of Lamb at three months.*

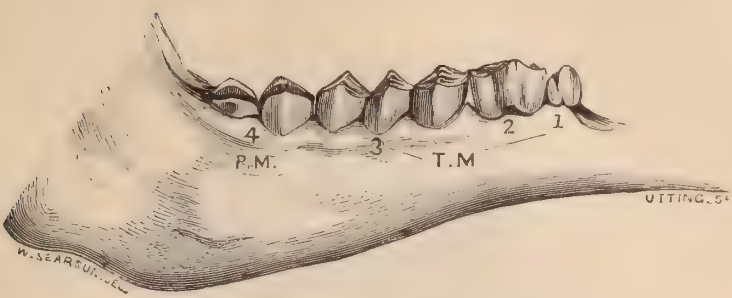
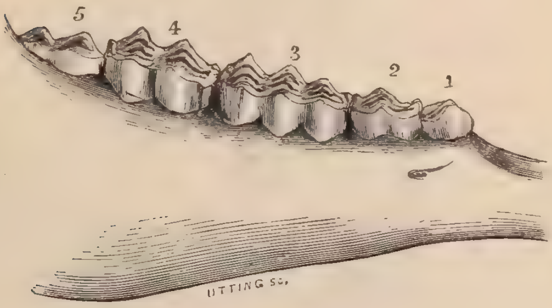


Fig. 36.—*Molars of Sheep at nine months.*



A one-year-old sheep's teeth will present the following appearances. Incisors are worn on their upper surfaces, especially the central and middle teeth. In sheep which are feeding on turnips, some of the incisors, and in certain cases all of them, are broken off, and in very forward animals the central permanent incisors are cut, but they are never perfectly level and regular at this age. In the drawing (Fig. 37, p. 426), the average state of the incisors in a well-preserved mouth at the age of one year is shown.

Looking at the back of the mouth, the examiner will see the fifth permanent molar standing well out from the jaw, while the teeth in front of it are all worn on the surfaces; these appearances, taken in connection with the state of the incisors, will enable him to assert that the sheep is about the age of one year.

The first broad teeth, central incisors, are usually cut soon after one year old, and are well up at fifteen months as shown the next illustration (Fig. 38).

At eighteen months the sixth permanent molar is cut, and the

Fig. 37.—*Incisors of Sheep at one year.*

Fig. 38.—*Incisors of Sheep at fifteen months.*

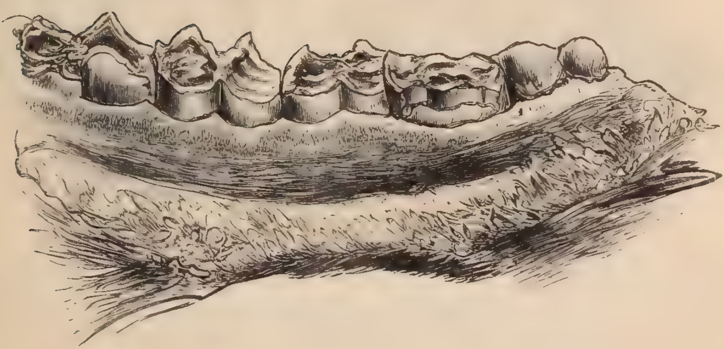
recent appearance which this tooth presents is better evidence of this age than can be obtained by an inspection of the incisors. Occasionally in very forward mouths the second pair of broad teeth will be cut; in other cases there will be no signs of their appearance until the sheep is approaching the age of two years; so far, therefore, as these teeth are concerned, the examiner is left in doubt as to whether the sheep is one year and six months or two years old, and it is absolutely necessary that he should inspect the molars, in which important changes occur between the ages of fifteen months and two years.

As the sheep approaches one year and a half, the sixth molar begins to protrude through the gum, and shortly afterwards the two anterior temporary molars have given place to the permanent teeth, and the third temporary molar is a mere shell

covering the top of the permanent tooth. This condition of the mouth is represented in the next figure (Fig. 39).

Fig. 39.—*Incisors and Molars of Sheep at one year and ten months.*

A. Incisors.



B. Molars.

The presence of six broad teeth in the front of the mouth is shown in the next illustration (Fig. 40).

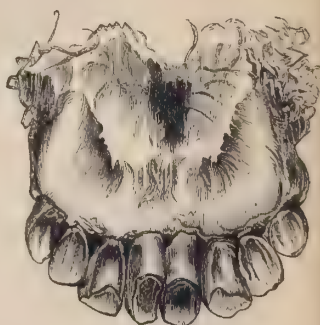
These teeth may be looked for in many sheep which are entered as not exceeding two years old, and no objection can be made on this ground, although the third pair of incisors are not, under ordinary circumstances, present before two years and three months.

Some difficulty may arise in the mind of an inspector who finds these different appearances in sheep which are in adjoining pens, or even in the same pen. But in such circumstances no hesitation need be felt in accepting the evidence of the molars, and disregarding that of the incisors.

The cutting of the corner incisors, or fourth pair of broad teeth, takes place on an average about nine months after the lateral incisors are in the mouth, and may be taken as an indication that the sheep is over the age of three years. In some cases the corner teeth do not appear till the animal is nearly four years old, so that there is a possibility of a mistake being made as to the age, to the extent of a year, by an examiner who contents himself with an inspection of the corner incisors. No difficulty, however, would be experienced in deciding whether the corner incisors represent three years or four years, if the state of the other incisors is taken into account. At four years

Fig. 40.—*Incisors of Sheep at two years thirteen months.*

Fig. 41.—*Incisors of Sheep at four years.*



of age the six broad teeth will show marks of wear, the central incisors especially will be worn hollow on their upper surfaces, the middles and laterals also showing well-marked tables in the place of sharp cutting edges; while the recently cut corner incisors, supposing their eruption to have been delayed till the sheep was nearly four years old, will present a marked contrast to the rest of the teeth which have suffered from attrition. These appearances are shown in the drawing (Fig. 41) of the mouth of a sheep of the age of four years.

After the age of four years, and indeed from the time of the completion of permanent dentition, whether early or late, the changes which are effected in the form of the incisors by wear vary according to the nature of the food, and the examiner must be content to limit his inquiries to the period within which is comprised the eruption of the permanent teeth.

The Teeth of the Pig.

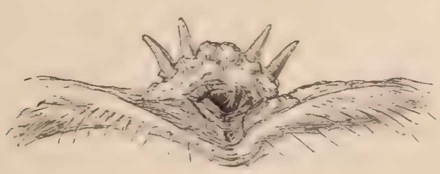
When the dentition is perfect, the pig has six incisor teeth in the front of both upper and lower jaw—two central, two lateral, and two corner teeth. Behind the corner teeth are the tusks, one on each side, in the upper and lower jaws. Between the tusks and the molar teeth there are usually four small teeth which are described as premolars, then one on each side of both jaw, and twenty-four molars, six on each side of the upper and lower jaws.

Temporary and permanent incisors agree generally in number, form, and position, but the temporary molars are only three in number on each side of the upper and lower jaws, and the third molar has three cusps instead of two. The temporary tusks are much smaller and more pointed than the permanent teeth which replace them, and the premolars are not represented by temporary teeth, but are permanent from the first.

It may be observed that no difficulty is found by the expert in distinguishing the permanent incisors from the temporary organs, especially when both orders are in the mouth together. The distinction is not, however, so marked as to secure the tyro from risk of error.

At birth the pig has two sharp-pointed teeth laterally placed in each jaw, top and bottom, leaving an open space in the front of the mouth (Fig. 42). The teeth much resemble small

Fig. 42.—*Teeth of Pig at birth.*

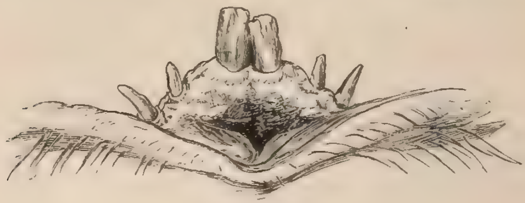


tusks; they are really the temporary tusks and corner incisors. No other teeth are in the mouth at the time of birth; but the temporary molars are immediately under the gum, and in the dried specimen they can be distinctly seen in their relative positions.

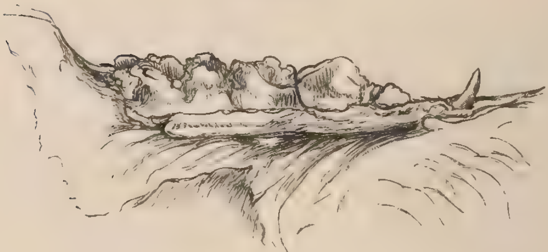
At one month old the three temporary molars on each side of the jaw, top and bottom, are cut, the second and third in position being well up, the first one just appearing through the gum; at the same time the two central temporary incisors in each jaw are cut, as shown in the illustration (Fig. 43).

At two months old the temporary central incisors are fully developed, and there are signs of the eruption of the lateral temporary incisors, which generally pierce the gums soon after two months. The first temporary molar is now nearly level with the second.

Fig. 43.—*Incisors and Molars of Pig at one month.*



A. Incisors.



B. Molars.

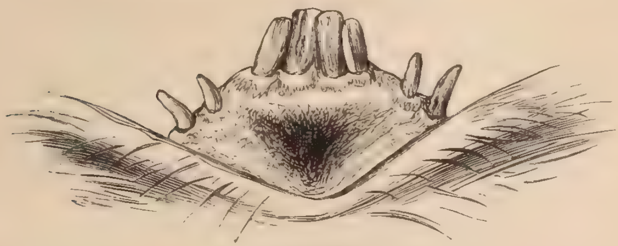
At three months old the pig has the temporary set of teeth fully developed, the lateral incisors by this time being nearly level with the centrals. The temporary corner teeth and the tusks are further removed from each other than they were at birth, owing to the growth of the jaw. In Fig. 44 the state of the teeth at three months old is indicated.

Excepting the natural growth of the jaws, in common with other parts, no changes occur which will assist the examiner in judging the age of the young pig until the age of five months is reached. At this time there are evident signs of the cutting of the pre-molars; and also the fourth molar, which is the first permanent tooth seen behind the temporary teeth.

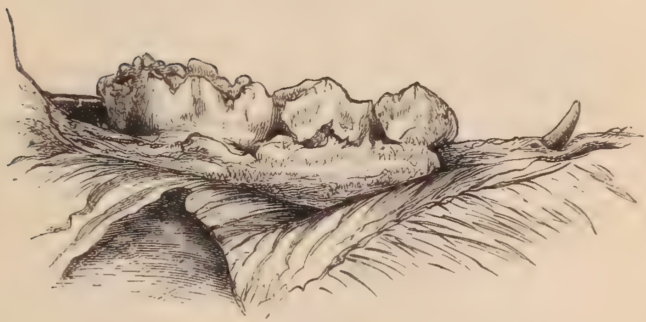
The woodcut (Fig. 45) shows the state of dentition at the age of six months.

As a large number of pigs are entered at Agricultural Exhibitions at the age of between five and six months, it is necessary to devote particular attention to the signs which are exhibited by the teeth of the pig at this period; and the inspector is particularly required to remember that the animal

Fig. 44.—*Incisors and Molars of Pig at three months.*

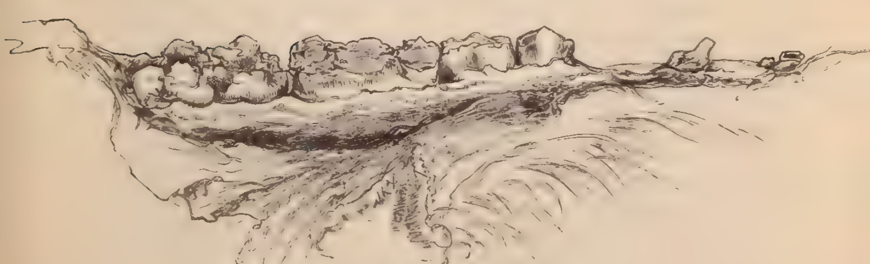


A. Incisors.



B. Molars.

Fig. 45.—*Molars of Pig at six months.*



which he is inspecting may be actually over the stated age at the time of inspection, without, in consequence, being liable to disqualification. This condition of things constantly occurs at the Shows which are held after the date up to which the ages are calculated; it is obviously necessary to add the days or weeks which have elapsed, to the animals' certified age, at the time of making the examination; for example, in cases where ages are calculated to the 1st of June, while the Show takes place early in July, a pig which is certified to be five months three weeks and five days old in the class for animals not exceeding six months, will be more than a month over the certified age when it is seen by the inspector.

Again, it must be noted that the premolars are not always developed, and in the same litter one or two pigs will be found occasionally in which this tooth is absent. The fourth molar is, however, remarkably regular in its appearance, and may be referred to for the purpose of resolving any doubt which may arise in consequence of the absence of the premolars.

Disqualification of a pig or pigs entered as not exceeding six months would occur under such circumstances as the following. The inspector, it may be supposed, is examining the teeth of a pig which is entered as five months and two days; he adds the weeks which have elapsed since the date up to which the age is calculated, and deals with the animals as having arrived at the age of six months and nine days. At this period he expects to find the premolars and the fourth molar well up, the fourth molar being close to the angle of the jaw, and scarcely free from the covering of gum at the extreme posterior part. But if the fourth molar stands out from the angle of the jaw, leaving space behind it, and if he observes in addition that the temporary corners have been changed for permanents, he does not hesitate to assert that the pig is at least a month older than it is certified to be. In some pigs the corner permanents are found with their points through the gum at seven months, but in the majority of cases the temporary organs remain till the animal has reached the age of eight months.

At nine months, the corner permanent teeth are well up, and the presence of the permanent tusks may be through the gum in very forward animals at this age. In looking over the notes of the inspections which have been made for many years past, it is quite certain that, as a rule, the pig at the age of nine months has the temporary tusks, or at least some of them, still in position; in fact, the presence of well-developed tusks in a pig entered as not exceeding nine months would be a fair ground of disqualification, unless the animal were a boar, in

which case early development of the tusks is expected. The drawings (Figs. 46 and 47) show the state of the teeth at nine months.

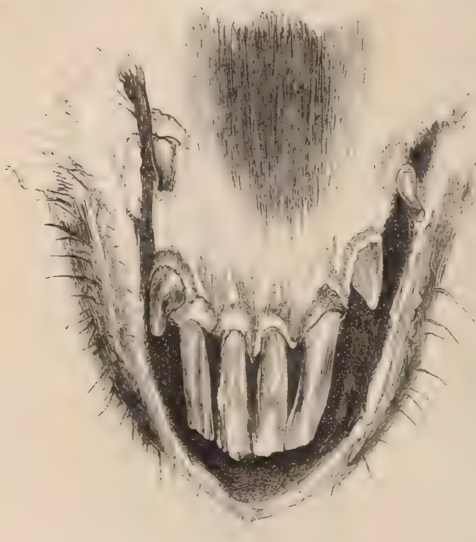
Fig. 46.—*Molars of Pig at nine months.*

A class for pigs not exceeding nine months of age at many Shows takes the place of the six months' class, and therefore includes pigs of various ages from two or three months to over eight months. Disqualifications in this class generally affect pigs which are really under nine months, in which the state of the dentition indicates the age to be above that which is stated in the certificate. If, for instance, a pig which is entered as five months and two weeks has the corner teeth just cut, or one entered as six months and twenty-one days shows evidence of

the changing of the temporary tusks, in these cases no hesitation is felt in disqualifying the animals.

One year old is the age when, according to received opinions, the central permanent incisors are cut. It is, however, the rule to find the temporary incisors still in their places in pigs which are just under the age of one year; and although the permanent teeth, when cut, advance very rapidly, a pig entered as not exceeding one year would be looked upon with much suspicion if the central permanent

Fig. 47.—*Incisors and Tusks of Pig at nine months.*



incisors were found to be fully up; and if, at the same time, some of the anterior temporary molars had fallen, and the permanent teeth were filling their places, the animal would be disqualified.

The fifth molar tooth is always cut between ten and twelve months, and its perfect eruption may be taken as evidence that the pig has reached the age of one year. In the illustration (Fig. 48), the recently cut central incisors are shown, a state of dentition which is seen in very forward animals at the completion of one year of age.

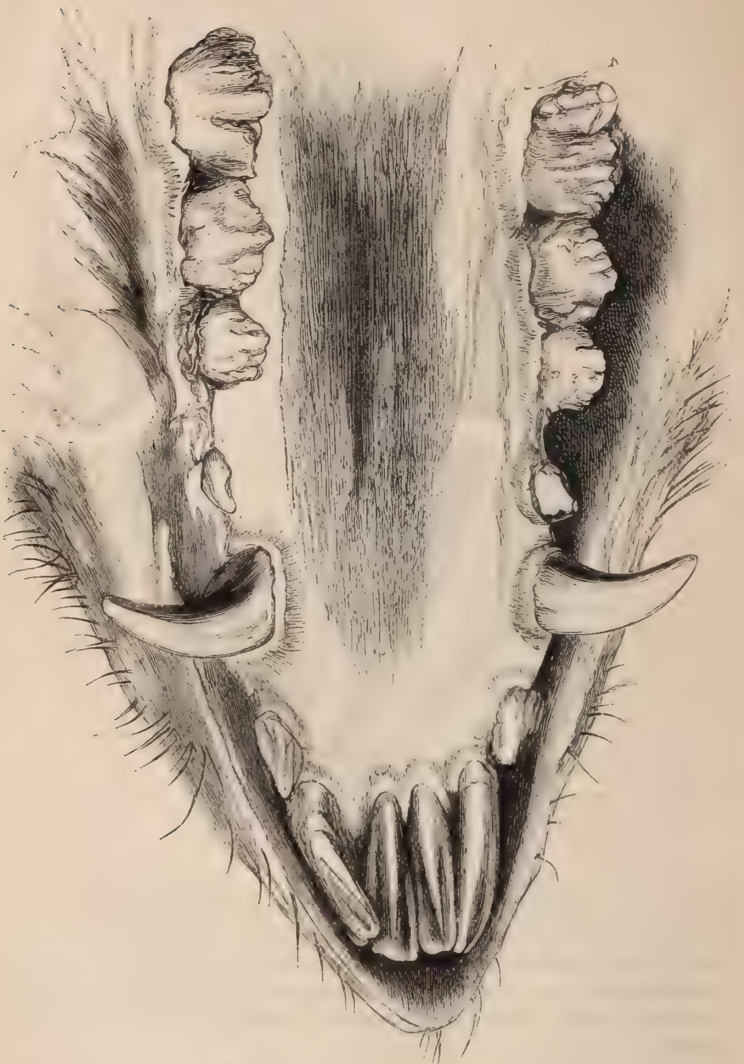
Shortly after the completion of one year, the three anterior temporary molars fall irregularly; and by the time the animal is fifteen months old, the three anterior permanent molars are in

Fig. 48.—*Incisors and Tusks of Pig at one year.*

the mouth, and may be readily known by their sharp unworn points, and their recent appearance, as shown in the illustration (Fig. 49, p. 436). These teeth are very regular in their development, and afford valuable evidence in cases where an opinion cannot be formed from an inspection of the incisors alone.

The next change in the dentition is the final one, and occurs between the age of seventeen and eighteen months. At this period the sixth molar, a permanent tooth, is cut; and in forward animals the lateral temporary incisors are changed for permanent teeth. In many instances the temporary lateral teeth remain up to the age of eighteen months, although they are in such cases quite loose; and very often the permanent teeth are

Fig. 49.—*Teeth of Pig at fifteen months.*

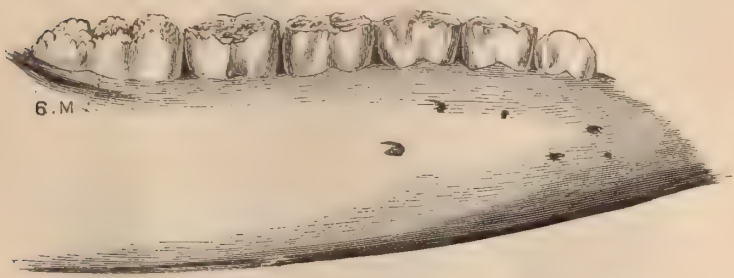


cutting through the gum below or by the side of them ; in other instances one lateral is found to be fully up and nearly level with the centrals, while the other is just pushing through the gum. The sixth molar is also fairly up, but the posterior part of its crown is not quite clear from the gum. These changes complete the permanent dentition of the pig, and there are no

indications of the age afforded by the teeth after this period, excepting such as depend on the growth and wear of the organs.

In the next illustration (Fig. 50) the sixth molar is shown as it appears at the completion of the age of eighteen months.

Fig. 50.—*Molars of Pig at eighteen months.*



It is very important that the examiner should exercise the greatest circumspection in the inspection of the teeth of pigs which are exhibited in the class above twelve and not exceeding eighteen months old. Animals are entered at various ages from twelve to eighteen months; it is necessary therefore in this class to note the condition of the central incisors and the anterior molars, as well as that of the lateral incisors and the sixth molar. In the next drawing (Fig. 51, p. 438) the full development of the lateral permanent incisors is shown. This state of dentition, it may be remarked, is indicative of a year and eight months.

At the age of two years the lateral permanent incisors are quite level with the centrals and are worn on their edges, the sixth molar now stands quite free from contact with the angle of the jaw, and indications of wear may be observed on the upper surfaces of the other molars. After the pig has attained the age of two years, an opinion as to the age must be to a great extent speculative. The wear which the teeth undergo, and the darkening of their colour, and the growth of the tusks, will afford some evidence which will assist the judgment; but there are no changes which can be referred to as indicative of the exact age of the pig after the lateral incisors and the sixth molars are fully developed.

In the course of the above remarks on the changes which occur in the teeth of the pig at different ages, certain exceptions to the rule of development have been mentioned; they are not numerous, nor very important in their bearings, and it is particularly worthy of notice that the exceptions are nearly always in favour of the exhibitor, being in the direction of retarded rather than accelerated development.

Fig. 51.—*Incisors and Tusks of Pig at one year and eight months.*

After an experience of some thirty years, I do not hesitate to affirm that of all animals on the farm, the pig is the most free from dental irregularities; and the evidence of age, which a skilled inspector may obtain from a careful examination of the teeth, may be accepted as free from any suspicion of error.

XXIII.—*Second Report of Experiments on the Development of the Liver-Fluke* (Fasciola hepatica). By A. P. Thomas, M.A., F.L.S., Balliol College, Oxford.

My experiments on the development of the liver-fluke were continued during the summer and autumn of last year, and other experiments have been performed during the present year, or are still in progress.

Renewed search was made for the intermediate host of the liver-fluke, and I again endeavoured to infect molluscs with the embryo. These experiments have been almost entirely confined to fresh-water snails. From the consideration of the geographical distribution of the liver-fluke, and of the various species of mollusca, I was led to strongly suspect *Limnæus pereger* of being the host of the long-sought larval form. The only two fresh-water snails found in the Faroe Islands, where the liver-fluke is very common, according to von Willemoes-Suhm,* are *Limnæus pereger* and *L. truncatulus*. The only aquatic pulmonate in the Shetland Islands † where the fluke also occurs is *Limnæus pereger*. If then the bearer of the larval form of *Fasciola hepatica* is a fresh-water snail, there is a strong case made out against *Limnæus pereger*.

But the question naturally presented itself whether more than one species of mollusc might not be able to act as carrier of the larval form. During previous investigations I had come across numerous forms of cercariæ, and many of these occurred in two or more species of molluscs, these again being frequently not the same species as those in which other observers had found the same cercariæ. I believe that the larval forms of trematodes are not so closely restricted to certain intermediate hosts as was formerly supposed, but that they may occur in any species which do not differ too widely either in the nature of their tissues or their habits of life. Some species will, however, be more sensitive than others to such differences.

It was therefore considered desirable to repeat infection-experiments on a number of our common water-snails. The common occurrence of the liver-fluke is perhaps partly due to several species of snails being able to serve as intermediate hosts. *Limnæus truncatulus*, in particular, I was inclined to suspect, as it was almost the only species of water-snail occurring on the clearly circumscribed area of infection at Wytham, mentioned in my former paper,‡ my suspicions being

* 'Zeitschrift für wissenschaftliche Zoologie,' vol. xxiii., p. 339.

† Forbes, British Association Reports, 1859, p. 127.

‡ First Report of Experiments. This Journal, vol. xvii. 1881, p. 19.

strengthened by the discovery of a peculiar species of cercaria in this snail, taken from a boggy place in one of the infected fields, a field in which I had myself seen a badly fluked sheep that summer, as I can testify from the examination of its liver. The habits, also, of *L. truncatulus* render it open to suspicion, as it, even more than *Limnæus pereger*, often leaves the water and crawls up the stems of water-plants and amongst the grass, &c., on the margins of ditches, and thus is liable to be eaten by stock feeding near the water. It may be found in very small quantities of water, such as slightly boggy spots in the centre of a field. But I was unfortunately unable to obtain specimens of *L. truncatulus* last summer, the localities near Oxford in which I had formerly found it were searched in vain. I went out repeatedly in quest of this snail, having on several occasions the skilled assistance of my friend and colleague Mr. W. Hatchett-Jackson, but we never found any other trace of this species than the empty shells. It could not be discovered in the localities given for it by Whiteaves in his paper on the Mollusca inhabiting the neighbourhood of Oxford.* My friends at a distance were appealed to, but were unable to assist me. The comparative freedom from rot of sheep in the neighbourhood of Oxford last year may be due to the real scarcity of this snail. This year, however, there were floods in July, and the waters of the Isis brought it down in vast multitudes; most of the examples were small, less than a quarter of an inch in length. So numerous was it, that a single sweep of a small hand-net repeatedly gave me more than 500 examples, and this was in a ditch where last year I could not obtain a single *L. truncatulus.* All along the margins of the ditches the ground was covered with them, and they were found abundantly on the flooded ground when the flood-waters had retired. A favourite position is on the under-surface of the blades of grass, not far from the damp roots, so that sheep grazing on such ground would inevitably eat large numbers of them, and as the size is small (the commonest variety only reaches the length of $\frac{1}{4}$ in. to $\frac{2}{5}$ in.), and the shell delicate, they would scarcely attract the notice of the sheep.

On returning three weeks later to the ditch where *L. truncatulus* had been found peculiarly abundant I was unable to find a single example alive. As I had not sufficient leisure on this visit to examine the ground near the ditch, I returned for the purpose of doing so eight days later. There had been dry weather since the flood, but early that morning heavy rain had fallen. I found specimens of *L. truncatulus* out on the gravel

* Proceedings of the Ashmolean Society. 1857.

of a path near the ditch, and these seem to have crawled out of the grass when revived by the rain. At the roots of the grass, along the margin of the ditch, others were found in abundance. Some few shells were quite empty, but the majority contained the dried remains of the snail, which had shrunk far back into the spire of the shell. Most of these appeared to be quite dead, but were however merely dormant, for on placing them in water the tissues imbibed moisture and assumed their normal bulk, and after a few hours the snails had regained their full activity, and were seemingly none the worse for their prolonged desiccation.

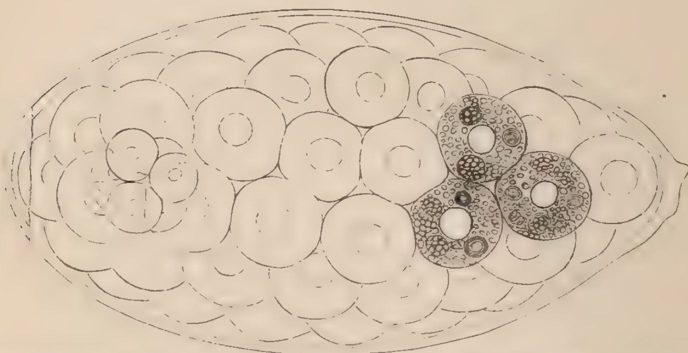
To give an idea of their abundance, Mr. Hatchett-Jackson and I collected from a comparatively small strip of ground at the side of the ditch mentioned, and within two hours, over 400 examples, and of these more than 300 are now living in my aquaria. When these snails are kept in an aquarium, they habitually crawl out of the water, and if not constantly put back will dry up on the sides of the vessel. Indeed, it may be well to note here that *L. truncatulus* requires special precautions to keep it healthy and active in confinement. It is clear to me from experience gained in this investigation that the species of snail under consideration, when left on the fields by the passing away of a flood, continues to wander and feed so long as the bottom of the grass remains moist. It is equally clear that the numbers so left are recruited from surrounding ditches and streams. A drought may render the snail dormant, but, unless too long continued, it revives at the first shower of rain. If there are fluke-eggs on the ground, and the season is wet enough for these to develop, the *L. truncatulus* will most certainly be infected with the larval forms of the liver-fluke, for, as will be seen further on, I have been able to prove that *Limnæus truncatulus* is the principal intermediate host of this destructive parasite.

The snails upon which my infection-experiments were tried last summer, were *Limnæus pereger*, *L. auricularis*, *L. palustris*, *Planorbis marginatus*, *P. carinatus*, *P. vortex*, *P. spirorbis*, *Physa fontinalis*, and *Bithynia tentaculata*. I was here to a great extent going over experiments already tried, at least for some of the species, by various workers as well as by myself during the previous summer, but always without success. As the cause of this want of success might lie partly in the abnormal conditions of snail-life in the laboratory, the experiments were performed in large aquaria, and much trouble was taken to secure favourable conditions of temperature, abundant food, &c., for the inhabitants. But though I obtained evidence that the embryos of the flukes do enter the snails, I was unsuccessful in obtaining any further development.

Experiments with Limnæus Truncatulus.

On obtaining the snails I had so long been searching for, I exposed a number to infection by placing fluke-eggs and free fluke-embryos in the vessel with them. The snails were speedily found to have afforded a suitable place for the further development of the embryos, and of those examined up to the present time all have proved to be infected, often containing as many as eighty embryos. Indeed, the infection was too successful, for about the tenth day many of the snails began to sink and die, simply because they were exhausted by the excessive number ot parasites, so that at the end of the fourth week I had only two left alive out of the eighty that had been infected.

Fig. 1.

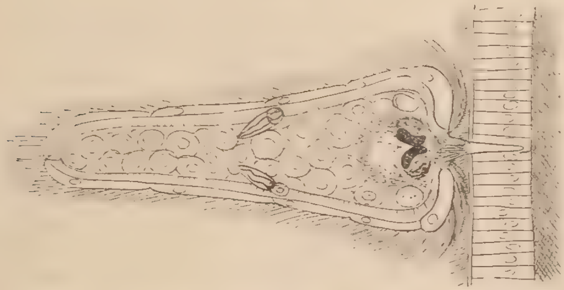


Egg of the Liver-fluke examined shortly after it was taken from the liver of a sheep. At one end of the shell may be seen the line marking off the lid, and a little below, the embryo in a very early stage of development, and surrounded by the secondary yolk-spheres, only three of which have been filled up. Magnified 680 diameters.

Before describing the changes which the embryo passes through, I will briefly mention its more important characters, referring to my former paper for fuller details. The free embryo of the liver-fluke has a bluntly conical form (see Fig. 2). The broad end is directed forwards, and in its centre is a head-papilla which is ordinarily short and blunt, but when employed for its purpose as a boring-organ becomes long and pointed (see Fig.). The whole surface of the body, except this head-papilla, is covered with a layer of flat cells, arranged usually in five rings around the body, and carrying long cilia, by means of which the animal swims rapidly through the water. Beneath these outer ectoderm cells is a layer of granular tissue, which contains transverse and longitudinal muscle-fibres. The longitudinal are more feebly developed than the transverse, and are only seen

with difficulty. At the anterior end the deeper layer of tissue contains the two crescentic eye-spots, which are now in contact, and are formed by two cells containing dark pigment. About the middle of the body on each side is a large tongue-like cilium in constant motion within a long funnel-shaped space. Each cilium is borne by a nucleated cell. Within the body-wall of the embryo is a space occupied in front by a granular mass in which no cellular structure can be seen, but which is probably a rudimentary digestive tract, and is filled behind with clear round nucleated cells—the germinal cells.

Fig. 2.

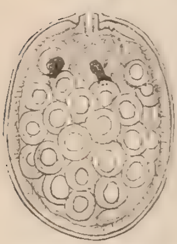


Embryo of Liver-fluke boring into a snail. Magnified 370 diameters.

The embryos which have entered the snail are, as a rule, found in the respiratory chamber, at the furthest point from the entrance, and close by the kidney. The embryos might swim in at the opening, though the snail is very sensitive to any touch in this neighbourhood; and an object so large compared with the size of the snail as the embryo is, would probably, in trying to enter, produce sufficient irritation to cause the snail to close the opening. I am inclined to think that the embryos enter by boring, and this view is supported by the occasional presence of an embryo in the body-cavity, or even in the substance of the foot. The first change the embryo undergoes after entering the snail appears to be the loss of the outer layer of flat ciliated cells, the cilia no longer being of any service. A thin cuticle is secreted by the body-wall and covers the whole of the outer surface. Embryos may sometimes be seen which have lost the ciliated cells, but still retain the conical form. This elongated conical form is, however, very soon lost, and the embryos take an elliptical shape, such as is shown in Fig. 3, p. 444. The eye-spots of the embryo become detached from one another, and lose their crescentic form; but they, as well as the head-papilla, persist, showing the identity of this young sporocyst—for such it is—with the embryo of the liver-fluke.

After the change of form has taken place the length is only about ·07 mm. Growth is very rapid, so that by the end of the third day the sporocyst has increased to ·15 mm. in length, still preserving the elliptical form. After this time growth is most rapid in the longitudinal direction, and the form becomes sack-shaped. At the end of a week the length is about ·22 mm. The rudimentary digestive tract remains for a time, but later on is no longer distinguishable. The germinal cells filling the sporocyst are now much more numerous, partly perhaps owing to the division of those already present in the embryo, but more especially owing to a proliferation of the cells of the inner wall of the sporocyst. If the sporocyst be much contracted, the germinal cells seem to fill up the whole of the space, and the cells which are still attached to the body-wall, and form part of its inner surface, cannot be distinguished from those which are lying free. But if a sporocyst be chosen for examination which is not in a state of contraction, cells with large nuclei may be seen in the clearest possible manner projecting here and there from the inner surface; sometimes in a single layer, at other times in rounded heaps, two or three cells deep. At about the beginning of the second week the mass of germinal cells is first seen to be breaking up into separate balls of cells—the germs of the next generation. The sporocyst continues to increase in size, the papilla is still seen at one end, and the two eye-spots behind, these often getting widely separated. Instead of the two ciliated funnels of the excretory system of the embryo, we may now distinguish as many as ten in the sporocyst, all being situated about the middle of the body. In each funnel may be seen a single large tongue-shaped cilium, carried by a nucleated cell. The vessels into which these funnels might be supposed to lead cannot be clearly seen. As the germs within the sporocyst increase in size they assume an oval and then a more oblong form. All the germs within a given sporocyst are not at the same stage of development. There is generally a single large one, with two or three of medium size, and several small ones. By the eleventh day we see that the germs are not destined to form a brood of cercariæ, that is, of those forms which enter into the sheep, but that they will form a second generation, reproducing asexually by the formation of spores within the body-cavity. In the most advanced germs which have the oblong form, we may now distinguish cells arranged to form a nearly spherical pharynx, which leads

Fig. 3.



Embryo of Liver-fluke soon after it has settled in the snail. Magnified 370 diameters.

into a short intestine, whilst towards the opposite end two short blunt processes grow out at the sides (Fig. 4). The sporocysts have now reached almost their full size, and they measure ·6 mm. in length. They are often of very irregular form, owing to the protuberance of the thin body-wall, caused by the developing germs.

Fig. 4.

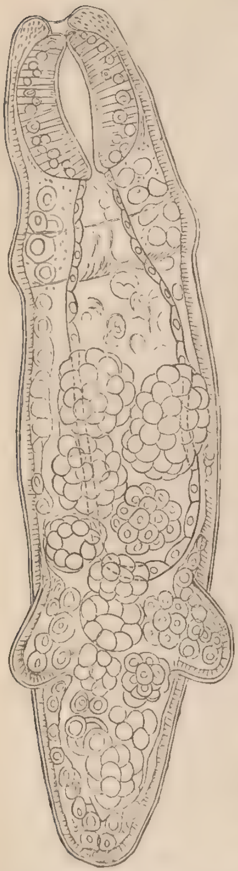
Adult sporocyst of Liver-fluke, containing several germs in different stages of development. The largest has assumed the character of a redia. Magnified 230 diameters.

By the end of the thirteenth day the rediæ are ready to issue from the sporocyst; they have now a more elongated form, and may measure as much as ·27 mm. in length, by ·11 in breadth. The surface of the body is covered with a delicate structureless cuticle, and a little way behind the pharynx the surface is raised up into a ring encircling the body, whilst near the opposite end are the two short stumpy processes. These are not on directly opposite sides of the body, but are nearer together, inclined nearly at right angles to one another. Beneath the cuticle is a granular layer forming the body-wall, in which flattened polygonal cells can be made out; and beneath these, strongly developed muscle fibres arranged in two layers, the outer layer of transverse being much stronger than the inner layer of longitudinal fibres. The pharynx is distinct, and the digestive tract is a simple sac, the blind end of which reaches a little way past the middle of the body. The whole of the space between the digestive tract and the body-wall is occupied by round nucleated germinal cells. The young redia shows active movements, and at length breaks its way through the wall of the sporocyst. The wound produced by its forcible exit closes up at once, and the germs still remaining continue to develop. The liberated rediæ begin to feed on the tissues of their host, and some of them at least migrate into the other

organs of the snail. I have found them in the liver with their digestive tract containing the yellow remains of liver-cells. In fact, the injury they do to the snails in forcing their way through the tissues gives rise to a serious mortality among the molluscs, so that only a few of my snails have survived three weeks after infection.

By the 23rd day the rediæ have reached the length of ·6 or .7 m. (see Fig. 5); and the germinal cells, increased in number by a proliferation of cells from the lining membrane of the body cavity, similar to that described in the sporocyst, have begun to separate into spherical germs. In some of these germs I observed evidence of the formation of a gastrula. The rediæ are very active; and when the snail is examined they soon contract the body-walls; but if observed at once, bridges or bridles of tissue composed of cells with their processes may be seen to cross the body-cavity in various directions. These I believe to be contractile. A little in front of the lateral processes of the rediæ may be seen ciliated funnels arranged in groups, and of the same nature as those in the sporocyst.

Fig. 5.



A free redia (second generation) of the Liver-fluke with the contents forming into germs of the third generation. Magnified 230 diameters.

The spherical germs increase in size, and assume an oval or almost oblong shape, but I have not, at the time of writing, been able to trace their development. They may prove to be another generation of rediæ, or the cercariæ which finally enter the sheep. I have still two snails alive which have been infected for nearly five weeks, and I hope on dissecting them to complete the cycle of forms belonging to the liver-fluke (see Addendum, p. 453).

Two points which I was enabled to make out during these experiments have a bearing upon the development of other species of trematodes besides the liver-fluke. In the first place I found that the snails swallowed the eggs of the fluke contained in the aquaria in large numbers. I had already observed that various species of slugs devoured eggs* strewn on their food without injuring them. But in the case of

* Journal of the Royal Agricultural Society, vol. xvii., p. 14.

these water-snails, the large numbers picked up from the bottom of the aquarium showed that the snails do not swallow the eggs accidentally, but intentionally, no doubt mistaking them for food. The eggs and the contained embryos are uninjured by their passage through the digestive tract, and may be swallowed over and over again. Such being the case, eggs will undoubtedly be often hatched during their passage along the digestive tract; and if the embryos are not killed by the action of the digestive juices, they have only to pass through the walls of the intestine or up the bile-ducts into the liver (an organ very frequently infested with sporocysts or rediæ) to find themselves, if in a suitable mollusc, in a favourable place for further development.

That the embryos hatched out in the intestine may escape injury from the digestive juices of the snail, I have been able to observe directly in the case of the embryo of the liver-fluke. An embryo of this species was seen escaping from an egg in the intestine of a small *Limnæus pereger*, and during the three hours it was under observation it remained alive and active, although bathed in the fluid contents of the intestine. In this case, the embryo was prevented, partly by the pressure of the cover-glass, and partly by the presence of other eggs, portions of undigested food, &c., from escaping from the intestine. But in another example of the same species of snail, an active embryo was found free in the body-cavity, and as the digestive canal had not been ruptured, it must have bored its way through the walls of the intestine, which contained very numerous eggs.

It is clear, therefore, that those snails which have this habit of swallowing the eggs may be exposed to infection with trematode-larvæ. The species in which I have more especially noticed the habit are sufficiently numerous (viz. *Limnæus stagnalis*, *L. pereger*, *L. auricularis*, *L. palustris*, *Planorbis marginatus*, *P. carinatus*, *Bithynia tentaculata*, as well as three slugs, *Arion ater*, *Limax agrestis*, and *L. cinereus*) to allow us to assume that it is very generally prevalent amongst our land and fresh-water molluscs.

Von Willemoes-Suhm published in 1873 a list of the trematode embryos then known.* Since then, that of *Distoma trigo-*

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* 'Zeitschrift für wissenschaftliche Zoologie,' vol. xxiii., p. 341. As no list of these embryos exists in English, it may be useful to give it here. The nineteen ciliated embryos are: *Fasciola hepatica*, *Distoma hians*, *D. laureatum*, *D. viviparum*, *D. trigonocephalum*, *D. nodulosum*, *D. cygnoides*, *D. longicolle*, *D. globiporum*, *D. folium*, *D. lanceolatum*, *Bilharzia hæmatobia* (see Dr. Cobbold's work on 'Parasites'), *D. pinnatum*, *D. signatum*, *Monostoma mutabile*, *M. flavum*, *M. capitellatum*, *Amphistoma subclavatum*, an embryo obtained from a retort-shaped egg out of *Anas*. The embryo of *D. lanceolatum* has the cilia on the anterior half of the body only. The eleven unciliated embryos are, *Monostoma*

nocephalum has been described by Von Linstow. Out of a total of thirty species, nineteen are covered externally with cilia, and eleven are without cilia. The ciliated covering present in many forms, including *Fasciola hepatica*, seems to indicate that the embryo is destined to be liberated in water, and to search for its molluscan bearer by swimming. But where the embryo is devoid of any ciliated covering, its chances of meeting with a host will be greatly increased by this habit on the part of various snails and slugs. Even with ciliated embryos infection may occur in both ways. In the case of land-molluscs—and the number of larval trematodes known to inhabit these has been largely increased by recently published observations of Professor Ercolani *—this mode of infection from the swallowed eggs would seem to be far more probable than the entrance of a free embryo either through the skin or into the pulmonary chamber.

Professor Leuckart has quite recently published a paper,† in which he states that he has discovered one reason of the want of success which had hitherto attended infection experiments. He has found that *Limnæus pereger* is at least one of the intermediate hosts of the liver-fluke, but that it is only the very youngest and smallest individuals that are liable to infection. The discovery was made in the following way. He had obtained, as he believed, some specimens of *Limnæus truncatulus*, and having exposed them to infection, succeeded in obtaining a further development of the embryos. But a closer examination of his snails showed that he was really dealing *not* with *Limnæus truncatulus* but, owing to a most fortunate mistake, with young specimens of *L. pereger*. According to his account, the ciliated embryo wanders into the young snail, and losing its layer of ciliated cells, changes into a sporocyst, within which rediæ (or germinal sacs provided with pharynx and intestine) develop. These rediæ are set free from the sporocyst, and within them are developed spherical masses of cells. But here, unfortunately, his observations end, for he has not been able to trace the further growth of these germinal spheres, though we may conjecture that they develop into the brood of cercariæ, that is, of those forms which eventually enter the sheep. Before the work can be regarded as completed, we must trace the cercariæ from the rediæ, and determine the form and manner in which they enter the sheep, whether

filum, M. faba, Distoma megastomum, D. tereticolle, D. ovocaudatum, D. perlatum, D. mentulatum, D. variegatum, D. cylindraceum, Gasterostoma crucibulum, G. fimbriatum.

* 'Dell' Adattamento delle specie all' ambiente. Memorie dell' Accademia delle Scienze dell' Istituto di Bologna.' Serie iv., tomo ii., 1881.

† 'Archiv für Naturgeschichte,' 1882, p. 80.

whilst still in the snail, or encysted on grass, &c. For this purpose it will be necessary to feed sheep with the suspected larval form.

I have endeavoured to confirm these results of Professor Leuckart in the case of young *L. pereger*, and have met with partial success, although my experiments have been restricted by the scarcity of the needful material. Fluked livers have been very rare during the past spring, and I have had great difficulty in securing the comparatively small number of fluke-eggs with which I have worked. I exposed about eighty examples of *L. pereger*, varying in length from 1·4 mm. to 4 mm., to infection. I have measured young *L. pereger* which have just escaped from the egg, and find that they are as nearly as possible 1 mm. long, so that many of my snails must have been sufficiently small. Although they were exposed to infection from a larger number of eggs than my examples of *L. truncatulus*, only a few of the smallest were found to contain embryos, and none of these proceeded far in their development. Some of the smallest of the specimens of *L. pereger* died very soon, possibly from injury done them by the parasite; but more than three-fourths, including all the larger ones, entirely escaped infection. Those snails which have reached the size of 3 mm. seem to enjoy an immunity which may be due to the greater firmness of their tissues. It will be seen, however, that *L. pereger* does not form so suitable a host as *L. truncatulus*, for in the case of the latter species all the examples, both large and small, that I have experimented with have so far proved to have been infected. As *L. truncatulus* is said to be a very widely distributed species, and is amphibious in its habits, it will evidently be by far the more dangerous bearer.

Leuckart says of the head-papilla of the embryo of *Fasciola hepatica*, that it "seems to function as a tactile organ." But I have no doubt that it really has the function I assigned to it in my former paper, viz. that it is a *boring-organ*.* The papilla is ordinarily short (its length is about ·006 mm.), the end is quite blunt, or may have a slight depression in the middle. But when the embryo begins to bore into any object, the papilla is protruded, and takes the shape of a cone with a sharp point and a bulbous base. I have repeatedly observed an embryo attempting to bore into the foot of a small snail placed upon the same slide with it under the microscope. The point of the head-papilla is directed towards the tissue of the snail, and the embryo turns round on its longitudinal axis, the cilia working actively and pressing the anterior end against the

* 'Royal Agricultural Society's Journal,' vol. xvii., p. 7.

surface of the snail, aided in this by the contraction of the body of the embryo, which is slowly drawn up and then rapidly extended. As the papilla sinks further and further into the soft tissues, acting as a wedge in forcing the neighbouring cells apart, it becomes long and narrow, and the bulbous enlargement at its base disappears. The papilla has now four or five times its ordinary length, and I have observed it penetrate between the columnar epithelial cells of a snail's foot to the depth of ·022 mm. (See Fig. 2.) I could never observe an embryo actually enter the snail in this way, the tissue of the foot being probably too unyielding, at least when pressed on by a cover-glass. The embryo withdrew its papilla, and searching for a softer place, at once recommenced its boring operations. I have, however, found embryos in the connective-tissue of the foot in other specimens of *Limnæus*, and these had evidently forced their way in by boring in the manner described. The layer of cuticular cells is shed, but the embryos do not die at once, notwithstanding that such a situation is unfavourable to further development.

A differentiation in the tissue of the head-papilla is visible in the form of a delicate rod-like structure occupying the axis, not distinct enough to be called a spine, though it possesses considerable rigidity. It is particularly evident in preparations of embryos killed with osmic acid and stained with picro-carmine.

Leuckart states in the same paper that he received a number of specimens of *L. truncatulus*, gathered from the banks of the Main, and at once examined these for larval trematodes. He found three different kinds of rediæ. One of these contained tail-less distome-larvæ, and notwithstanding that the rediæ differ in certain respects from those found in his infection experiments (they have no lateral processes), he thinks he is justified by the characters of the included larvæ in considering this form to belong to the liver-fluke, at any rate until further results are obtained. His reasons are: 1, the larvæ included in the rediæ are tail-less forms, which may indicate that they are not destined to leave the snail in which the redia is found; 2, the surface of the larvæ is beset with spines; 3, the relative sizes of the oral and ventral suckers are much the same as in the liver-fluke. He was unable to test the matter by feeding a sheep with these tail-less larvæ, as he found them in only one of the snails.

In endeavouring to refer the young larvæ of *Distomidæ* to their respective adult forms, we have but few characters upon which we can rely, as so many of the most conspicuous characters of the young are only transitory larval peculiarities, whilst

on the other hand many of the organs of the adult are not visible in the young, even in rudiment. The most valuable of the permanent characteristics are the relative proportions of the suckers and the nature of the cuticular structures. It is usually considered that the suckers preserve the same relative proportions during growth; but such is not the case in *Fasciola hepatica*, for here the ventral sucker grows relatively more rapidly than the oral. This is perhaps only natural, as the hinder portion of the body rapidly outstrips the anterior portion during growth, as it contains the reproductive organs. This fact is of greater importance, seeing that we have so few characteristics to assist us in the difficult task of connecting the larva with the adult. In the adult, the diameters of the oral and ventral suckers are on the average in the ratio 1 : 1·35, though there is much individual variety. In the largest fluke I possess, 34 mm. in length, the ratio is 1 : 1·42. But in the smallest specimen I have yet found, which was only 1·1 mm. in length, the two suckers are of exactly equal size, and the same is the case in a specimen 2·2 mm. in length. Examples of the size of the latter, however, have usually the ventral sucker rather larger, the ratio of the oral to ventral sucker being on the average about 1 : 1·1. In still larger examples, 6–8 mm. long, the ratio is about 1 : 1·2. It may be inferred, therefore, that the suckers in the larval form of the liver-fluke scarcely differ in diameter, though the ventral may possibly be the larger to a trifling extent. In the tail-less larval form found by Leuckart, the ratio of the suckers was as 7 : 8 or 1 : 1·143.

It is worthy of mention in this connection that no less than ten species of rediæ or sporocysts have been recorded containing tail-less distome-larvæ instead of the more usual tailed cercariæ. Most of the species appear to be good, though others are very imperfectly known. De Filippi described under the name of *Distoma paludinæ impuræ inerme*, a tail-less distome-larva, which has many points of resemblance with the one found by Leuckart, and was produced in a similar redia without any lateral processes, and he proved that it was the larval form of *Distoma perlatum*, found in the tench, &c. From these observations of De Filippi it seems probable that the tail-less form found by Leuckart is destined to develop in a cold-blood host rather than in a mammal.

Another of the rediæ found in *Limnæus truncatulus* appears to be the same as the one I had already met with in the same snail on infected fields at Wytham.* The cercariæ produced with it are characterised by the presence of a lobed lateral organ,

* 'Royal Agricultural Society's Journal,' vol. xvii., 1881, p. 19.

composed of coarsely granular cells. Leuckart does not consider that this cercaria has any connection with the liver-fluke, partly because he did not detect any spines upon the cuticle. I have seen the same larval trematode since writing my former paper, though not in sufficient quantity to allow me to try feeding experiments, and I am able to say that the cuticle of the oldest cercariæ is beset anteriorly with spines; in the less mature cercariæ they could not be seen. It appears to me that this form is to be regarded with suspicion for the following reasons: 1. Its anatomical characters are not contradictory to the idea that it may prove to be the larva of *Fasciola;* the cuticle of the anterior part of the body is finely spinose, and the oral and ventral suckers are of nearly equal diameter, the ventral being sometimes a little the larger. The lobed lateral organ I regard, for a reason already given,* as merely a passing larval character. 2. The rediæ show a greater resemblance to the young rediæ descended from fluke-eggs, as I have observed them, than do those containing tail-less distomes. The resemblance indeed is very striking. 3. The cercaria has the suspicious habit of encysting itself upon water-plants, grass, &c. Moreover, I have twice met with this cercaria in the course of my investigations—on one occasion in almost the only mollusc that could be found on the scene of an outbreak of the liver-rot at Wytham, whereas I have never found the tail-less larval form mentioned by Leuckart. Experiment must decide whether this, or the tail-less form in question, or some other cercaria, is the juvenile form of the liver-fluke.

It gives me much pleasure to take this opportunity of thanking Dr. Acland for kindly permitting me to use the Sanitary Laboratory, in which I am continuing my experiments.

It would greatly assist me in bringing my researches to a speedy and successful termination, if any gentleman who is interested in the question could kindly forward to me, at the University Museum, Oxford, gatherings of snails, more especially of *Limnæus pereger* and *L. truncatulus*, from the scene of any well-marked fresh outbreak of fluke-disease, or from ground which is known always to give the rot. The snails should be as numerous as possible, and should particularly include young and half-grown examples. The accompanying figures represent the two kinds of snails, towards

Fig. 6.

1 2 3

(1). *Limnæus pereger*, an average specimen, natural size. (2). *Limnæus truncatulus*, twice the natural size. (3). The same. A common variety, natural size.

* 'Royal Agricultural Society's Journal,' vol. xvii., 1881, p. 20.

which, in the present state of the investigation, the evidence points most strongly as the bearers of the larval form of the liver-fluke, and which I desire to obtain from infected fields. With regard to the precautions to be taken against the liver-rot, I am able to say now still more definitely, that to prevent sheep from getting the disease, they must be kept away from all ditches, marshy places, &c., where such snails can be found.

Addendum.

Since the above report has been in type I have carried my researches further, and have been enabled to complete the cycle of forms which occur in the life-history of the liver-fluke.

In a *Limnæus truncatulus* dissected on the thirty-first day after the first exposure to infection, I found that the rediæ of the liver-fluke had much increased in size. The largest was 1·12 mm. long, and ·23 mm. broad across the middle of the body. The larger rediæ contained nearly a score of germs in various stages of development. The smaller were still spherical; the larger ones, situated more anteriorly, were of an irregular oval shape, with a smooth surface, and enclosed each in a loose and delicate pellicle. The largest germ was ·116 mm. long by ·073 broad. But there was no clear evidence as to the form these spores would assume.

In another snail dissected at the beginning of the seventh week after infection, I found rediæ containing cercariæ, and although the latter were not quite perfectly mature, they were still far enough advanced to enable me to determine the character of the cercaria. I have mentioned above that Professor Leuckart found tail-less distome-larvæ in a redia in *L. truncatulus*, and that, inferring simply from the anatomical character of the larvæ, and notwithstanding that the form of the redia was unfavourable to such a conjecture, he considered himself entirely justified in assuming, until further results, that these belonged to *Fasciola hepatica.* But I have already shown that the characters of the redia and larvæ furnished me with reasons for gravely doubting the correctness of this conjecture, and from my further researches I am now warranted in asserting that this tail-less form does not belong to the liver-fluke, for the true cercaria descended from the embryo of the fluke has a tail of considerable length. The body of the cercaria is about a quarter of a millimeter in length, the oral and ventral suckers are of nearly equal size (·05—·06 mm.), the ventral sucker being situated just behind the middle of the body. The pharynx is quite distinct, and the digestive tract is simply forked, the two

divisions reaching to the end of the body, but not showing any of the numerous branches so characteristic of the adult. Around each cercaria and germ is a loose delicate pellicle.

The rediæ containing the cercariæ still shows the characteristic ring running round the body a little behind the pharynx, and at the hind end are still visible the two short lateral processes, now, however, more stumpy than in the younger rediæ. The digestive tract was short, being only ·24 mm. long in a redia of four times the length.

There can be no doubt that the cercariæ I found really belong to the liver-fluke. The rediæ in which they occurred were closely similar to those I have found throughout in the examination of the snails I have infected with embryos, and in the same snail with these rediæ was a sporocyst, still recognisable by the eye-spots and papilla as belonging to *F. hepatica*. Moreover, *all* the specimens of *L. truncatulus* which I infected have proved to contain larval trematodes, clearly belonging to one and the same zoological species, and as a preliminary precaution a number of snails of the same gathering as those submitted to infection were examined, and all were completely free from larval trematodes.

In the same snail I found also rediæ producing not cercariæ but other rediæ, which we may term daughter-rediæ. Indeed I have not been able to prove as yet whether the rediæ forming the second generation in the series of forms belonging to the liver-fluke ever produce cercariæ. In many cases, at any rate, the cercariæ only appear as the fourth generation, and it may be that this is always the case. The rediæ generating rediæ appear to have a larger pharynx and intestine, and to contain fewer germs than those producing cercariæ. I saw as many as three well-formed rediæ in a single parent-redia in addition to several smaller germs. The ring behind the pharynx is well-developed, and in one parent-redia I found it so large that the diameter of the body was nearly doubled at this point.

I reserve further details as to the structure of the cercaria and redia for a subsequent paper. I may, however, mention that the existence of as many as four generations gives rise to a great increase in number whilst within the snail; so that a single fluke-egg may well give rise to over 1000 cercariæ.

The one point remaining that I have still to elucidate is the manner in which the cercariæ are transferred to the sheep, and this I hope very soon to accomplish. This may be effected either by the sheep eating the mollusc containing the cercariæ, or the cercariæ may pass out of the snail and encyst upon grass, &c. The presence of a tail is certainly in favour of the latter view. Leuckart is inclined to believe that the larval flukes are

swallowed with the snail containing them, principally on the ground that when flukes are found in an animal, they are usually very numerous. But a stroll round the Oxford meat-market is quite enough to convince one that sheep often contain a very limited number of flukes. The bile-ducts of the liver are then opened, the flukes removed, and the livers sold for food. Moreover, I have often had livers sent me which contained a very small number of flukes, on one occasion only a single fluke, on another occasion seven.

XXIV.—*Flax for Paper-making.* By RICHARD STRATTON, The Duffryn, Newport, Monmouthshire.

IN the thirty-fourth volume of this 'Journal' there appeared two interesting articles on the growth of Flax, and its preparation for linen as practised in Ireland and on the Continent, by Michael Andrews, Esq., and H. M. Jenkins, F.G.S., respectively.

The point of these articles appears to be the question whether flax cannot be profitably grown in this country for the purpose of linen-making, and whether, as corn-growing has proved so disastrous for some years past, with every probability of a continuance of low prices, farmers would not do well to turn their attention to other crops that seem to offer a better prospect of remuneration.

A propos to this, I propose very briefly to relate my little experience as a grower of flax, and to offer a few remarks upon the general question whether flax-growing ought not to be taken up by the British farmer.

In the spring of 1880 I received a letter from Mr. A. Reed, the manager of the Ely Paper Works, near Cardiff, informing me that he had lately been using a little flax in the manufacture of his paper, that it answered well, and suggesting that I should grow some for him. I agreed to try a few acres, Mr. Reed paying me 4*l.* 10*s.* per ton for the straw, straight from the threshing-machine.

I selected a field of 8 acres, a sandy loam of moderate depth, on a gravel; it had been manured with about 15 tons of farm-yard-manure, and ploughed in the winter. The previous crops were oats, *three years in succession*, grown entirely by the aid of nitrate of soda, no other manure having been applied. It will therefore be seen that the land was poor, not to say starved. I had intended to bring it into roots, but, as it was tolerably clean, and not caring to make my first experiment too flattering, I selected it for flax, which, after a couple of scarifyings, and a

dragging or two, was drilled 8 inches apart with $1\frac{1}{2}$ bushel of seed in the second week of April.

The crop was weeded at a cost of about 2*s*. an acre, just the largest weeds being cut up, and nothing more was spent on it until harvest, which came about a week after the wheat.

I paid 1*l*. per acre for pulling, tying, and stooking, at which price the labourers made fair wages. The crop was somewhat interfered with in a few spots by wild vetches and "goose-grass" — the worst kind of weeds you can have in flax—but it yielded 22 bushels of seed and 32 cwt. of straw per acre.

	£	*s.*	*d.*
Value—22 bushels seed, 8*s.*	8	16	0
32 cwt. straw, 4*s.* 6*d.*	7	4	0
	£16	0	0

This result I considered highly satisfactory, so determined to grow a larger breadth the following year. I selected a field of 21 acres (having a similar soil to and adjoining the field just mentioned), which had grown eight consecutive hay-crops, followed by April wheat. It had been sown with Italian rye-grass and clover in 1875, and mown twice every year. Nitrate of soda was applied on two occasions, but no other manure of any kind. The clover having died out, the field was ploughed in the winter of 1879, and April wheat planted in April. The crop was as good as could be expected—24 bushels per acre—and the land, frightfully foul, was partially cleaned in the autumn, and thoroughly well finished in the spring, the couch being all burned, and the ashes thrown over the land. Seven hundred-weight of damaged decorticated cotton-cake per acre was then sown, and the flax-seed—$1\frac{1}{2}$ bushel—drilled in the middle of April. The crop was hand-hoed at a cost of 5*s*. per acre. Nothing could be finer than this crop, as thick as it could stand, and about a yard high. Just before it was ripe, wet weather set in, and more than six weeks elapsed between the time we started pulling and the day we finished carrying; yet no shedding was observable, excepting where a small piece was pulled and laid on the ground, when, owing to continuous wet, a certain amount fell out or sprouted. Of course, owing to over-ripeness and continual washing, the straw lost considerably in weight. Not only was it lighter when carried from the field, but it lost much in threshing, a larger proportion having gone to "cavings," yet the result was satisfactory, viz.:—

	£
40 cwt. straw per acre, 4*s.* 6*d.*	9
20 bushels seed, 8*s*...	8
	£17

It will be observed that I got no more seed from 40 cwt. of straw, than from 32 cwt. the year previous. This is probably owing to the wet weather, which prevented the seed filling as it should have done; moreover, the crop was too thick for a large crop of seed. The next instance I have to record is not so satisfactory.

Ten acres of somewhat tenacious soil on the Old Red Sandstone was selected. A fair crop of swedes had been, for the most part, fed off with the ewes and lambs without cake or corn. It was the last of the roots, and they were not finished until the end of April.

The land was ploughed at once, and knocked about with drags, &c. It worked unkindly, owing to the treading of the sheep, but, as it was getting late, we rolled the ground and drilled the seed—1 bushel per acre—about the 7th of May.

Owing to the roughness of the ground, the seed shook out of the cups, and we did not drill so much per acre as we intended. Again dry weather set in, and some of the seed did not germinate, or did so only to be dried up; consequently, the crop was too thin, and the result meagre compared with the other two I have mentioned.

		£	s.
Yield—15 bushels seed per acre, 8*s*.	..	6	0
16 cwt. straw, 4*s*. 6*d*.	..	3	12
		£9	12

It will be evident that in this case flax ought never to have been planted, the essential condition of success, namely, a fine seed-bed, was absent; but I was anxious to bring the whole field into clover; moreover, I wanted to see how flax would do under unfavourable conditions, and I am bound to say that I am confident that either barley or oats would have given a worse return.

The remainder of this field, where the roots were fed off in good time, the sheep eating cake, was planted with wheat in November, the land working well. The result was the most unsatisfactory of all my farming experience: it lost plant in the spring, blighted badly, and realised no more than 6*l*. per acre, corn and straw together. The whole field, 32 acres, was sown with clover, which came up well, and is an excellent crop, equally good after flax as after wheat.

The price at which I have put the seed, viz. 8*s*. per bushel, may be thought high, seeing that the quotations for crushing-seed are considerably below this price. As a matter of fact, I have averaged more than 8*s*. for all I have sold. I charge 10*s*. for seed, and the remainder, which I could not dispose of for

that purpose, I sold at 7*s.* 9*d.* for "domestic" purposes. Again, I see the quotations for clean linseed in the London market has been for a long time 65*s.* per quarter of 416 lbs. My seed has generally weighed close upon 56 lbs. per bushel; I have therefore made it that weight when sold, and throughout this paper, 56 lbs. is the weight of my bushel; I think, therefore, that I am not putting the price too high at 8*s.* per 56 lbs., especially as I am now told, on good authority, that the north of Ireland would be the best market for seed.

Having given shortly the *results* of my own experience, which it will be observed extends over two years only, I will now give that of my friend Mr. T. R. Hulbert, North Cerney, Cirencester, who, at my suggestion, grew a small field of flax on a poor shallow piece of soil high on the Cotswold Hills. The land had previously grown roots, which were fed off with sheep, eating corn. The seed ($1\frac{1}{2}$ bushel) was drilled 7 or 8 inches apart in the first week of May, and the crop yielded per acre:—

	£	s.
20 bushels of seed, sold at 10s.	10	0
1 ton of straw	4	10
	£14	10

In this case the land was in one or two spots much trodden by the sheep in wet weather, consequently worked badly, and the flax suffered accordingly.

This would be about double the value of the average of the corn crops grown on North Cerney Farm in the year 1881, the season having been one of the worst for corn in that district on record, with the exception of 1879.

It will be observed that 10*s.* per bushel was made of the linseed in this case, but, deducting the 2*s.* per bushel, and 20*s.* per ton for delivery and carriage of straw, the result then would be 11*l.* 10*s.* per acre—not an unsatisfactory price for a crop of corn grown on the Cotswold Hills, and not planted until May. The foregoing examples will prove at a glance to any practical farmer that, compared with corn-growing, flax has, in the cases mentioned, paid very much better, and must have left a good profit after paying all expenses: an eventuality not likely to have been realised in such seasons as 1880 and 1881 from corn-growing.

But before arriving at a conclusion on a point of this kind, it will be well to consider carefully the "pros" and "cons." I may say at once, that I am so satisfied about the pecuniary advantage of flax over corn, that I am this year growing 70 acres, or as large an acreage as I am growing of wheat; and but that I do not like having too many eggs in one basket, and that, after all, I have had only two years' experience, I should feel strongly

inclined to increase the proportion. I may here say that at the time of writing (July 15th) my crop of flax promises to be quite satisfactory, notwithstanding that, owing to the wet April, nearly the whole 70 acres was unplanted until May. Judging from appearances one would say decidedly that the crop will be far more likely to pay than either wheat or barley; and, notwithstanding the incessant rains, it appears certain to realise the average I shall hereafter allude to.

I propose now to describe the mode of cultivation, harvesting, &c., that I have adopted, or that I think should be adopted, to grow flax successfully; we shall then be in a position to see how these operations compare as to expense, &c., with the cultivation of a corn crop. I am fully persuaded, and this opinion is borne out by others who have had greater experience than myself, that the one essential condition of successful flax-growing is a fine seed-bed; anything like roughness in the land is fatal to the production of a really good crop of flax. The land intended for flax should be ploughed not later than February, and gradually worked down until about the middle of April, so that at each harrowing a crop of annual weeds may be destroyed; a scarifying to cut off colt's-foot, thistles, &c., that may be on the way to impede the crop, would be advisable just before drilling; then drill the same width as barley (say, 8 inches), $1\frac{1}{2}$ to 2 bushels of seed per acre. Care should be taken that the seed is not deposited too deep, or it will not germinate. The land being finely pulverised once over with the harrows after the drill will be sufficient, though if the land is addicted to annual weeds, a run over with very light harrows, or the chain-harrow, a week after drilling would have the effect of destroying another crop of these pests. These precautions against annual weeds may seem strange and unnecessary to many, but in this country they are the bane of the farmer's life; and it must be understood that paper-makers have the greatest abhorrence of these weeds—in fact, they would have all to be carefully picked out by hand before the flax is made use of. The quantity of seed to be sown per acre would depend upon circumstances; it appears to be quite clear from my own observation and from the reports of others that a light seeding produces a much larger crop of seed and a much smaller crop of straw, and of greatly inferior quality of fibre, than a heavy seeding. My object hitherto has been to get as much weight as possible of straw and linseed combined, without consideration as to the quality of the fibre, and I believe for this purpose $1\frac{1}{2}$ bushel of seed to be the best quantity to drill per acre. But the time may come, as in Ireland and elsewhere, where flax is grown for linen in the first place, and only the second quality of fibre is used for paper-making. It will then be advisable to plant

from 2 to 3 bushels of seed, and to pull the crop before the seed is ripe, and so sacrifice the seed-crop altogether; for there appears to be little doubt that the quality of the fibre is 50 per cent. more valuable in flax pulled green than when it is allowed to get thoroughly ripe. But so long as a uniform price is paid for the fibre, whether for good, bad, or indifferent, I think a seeding of about $1\frac{1}{2}$ bushel is the best. Drilling appears to be preferable to sowing, as it gives an opportunity for hoeing, which the other plan does not. I am inclined, therefore, to think that 8 inches between the rows is not too wide. I believe there is a notion among the Belgians that flax is a crop to be very delicately treated—they fear to harrow, roll, or even tread on the young plants; I have treated it exactly as I would barley; harrowed and rolled when an inch or so high, and hoed until seven or eight inches high, without, I believe, in any way injuring the crop.

The best manure for flax I am not prepared to state, but probably it will be found to be one rich in nitrates. I have used damaged decorticated cotton-cake with wonderfully good effect; and I understand that the Belgians, who are probably the best growers of flax, use rape-meal in preference to any other manure. This year I have used nitrate of soda on one field, with apparently (so far) very great effect; two of my brothers have also used nitrate of soda, and the effect on the straw is quite satisfactory; it is too early yet to judge of its effect on the seed.

Hitherto I have always pulled the crop, at a cost of 1*l.* per acre, without beer (for pulling, tying, and stooking); at this price in a fair crop a good man can earn 5*s.* a day. If the weather is fine, we let it lie on the ground for a day or two before tying, but in catching weather this is a dangerous plan, and I am inclined to think that, on the whole, unless the weather is thoroughly settled, it is better to tie in small sheaves as fast as it is pulled, and stook it at once, when it is practically safe. The time required in the field will, of course, depend on the weather, and the state of ripeness when pulled, but it will generally require more time than wheat or barley, but certainly not more than sheaved oats. I have put a large bulk together, and never had any heat observable. The advantages of flax over a corn-crop appear to me to be as follows:—

1. More profitable.
2. Far less risky, being virtually rain-proof.
3. Being generally a new crop, it is an entire change for the land, and therefore desirable.
4. However strong the land may be, flax will not lodge seriously, unless pulled down by bind-weeds; so that on land

where barley would certainly be too heavy, flax may be grown without any danger of that kind.

5. Birds do not touch it at planting-time, though, when ripe, finches are very fond of it.

6. It may be planted later than spring corn, thus affording more time to clean the land.*

7. It may be grown on land that cannot be depended upon to produce malting barley.

8. I believe it is practically proof against wire-worm.

9. Rabbits and hares do not eat it, though they will occasionally cut roads through it.

On the other hand it has the following disadvantages: The cultivation may cost 10*s*. an acre more than for wheat or barley, but it will be better perhaps to compare it with a spring crop, say barley, leaving wheat out of the question. The cost of harvesting will be 10*s*. an acre greater; and, if the ordinary threshing-machine is used, that process will be more costly; but a new process of separating the seed from the straw, by passing it between rollers, is about to be brought out, which will, I think, put the two crops on an equality in this respect. Assuming the preparation to be equal, say 10 tons of roots per acre fed off on the land with cake, the crop of barley may be calculated on good suitable soil to produce—

	£	s.	
36 bushels at 4*s*. 6*d*.	8	2	
30 cwt. straw at 1*s*. 6*d*.	2	5	spending price.
	£10	7	

This would be perhaps generally considered too high an estimate—at all events it would be highly satisfactory to the grower. Under the same conditions I think flax may be *safely* estimated to produce as follows:—

	£	s.
20 bushels seed, 8*s*.	8	0
30 cwt. straw, 4*s*. 6*d*.	6	15
	14	15
Deduct extra cost of producing, say 1*l*. per acre (pulling and cultivation); threshing, 5*s*.; delivering, 10*s*. per ton	1	15
	£13	0

which leaves a balance of 2*l*. 13*s*. in favour of the flax. But in this estimate I feel confident that, owing to the less risky character of the flax-crop, there would be far greater certainty of

* There is a very nice crop in this neighbourhood, planted on May 24th this year.

realising the amount at which I have put that crop, than there would be of obtaining the 10*l.* 7*s.* for barley. In fact, the great drawback to the barley-crop is the utter uncertainty as to what it may produce: it may be 25*s.* per quarter, it may be 45*s.* The yield may be 3 quarters, or it may be 6. The straw may be worth 1*s.* 6*d.* per cwt., or 9*d.*, all depending on the weather; and the same remark applies to wheat. In the case of flax there is, I believe, no such uncertainty. No doubt the finer the season, the better all round will be the crop; but however wet the weather may be, the fibre is uninjured, the straw makes the same price to the paper-maker; and, notwithstanding six weeks of incessant wet, last harvest my seed was uninjured in any way, excepting in the case of a small quantity that was tied in the wet, or left untied on the ground. This freedom from risk is an advantage of the utmost importance, but impossible to estimate at a money value with any degree of accuracy. It should be particularly borne in mind that my experience has been gained in 1880 and 1881, two seasons by no means favourable for corn-crops, and probably no more favourable for flax.

In putting 30 cwt. per acre as an average weight of flax-straw, I am not only taking the result of my own short experience, but am confirmed in my estimate by Mr. Goulton, also by Mr. Thomson (Ligoniel House, Belfast, who is bringing out a book on 'Flax and Flax-spinning,' and to whom I am indebted for much interesting information), who says: "The produce of dry—or what is called *win-straw* — varies with the culture, quality of seed, season, &c., from 20 to 50 cwt. per English acre, recognised average or standard of fair crops being 30 to 40 cwt."

I also find in the 'Agricultural Magazine' of 1815, that 30 cwt. was considered an average crop in those days. I think therefore I cannot be far wrong in estimating an average crop to produce 30 cwt. of straw per acre.

To form a correct estimate of the probable average yield of seed is not so easy, as there are so few seed-growers in this country or in Ireland. I can only therefore judge from my own limited experience, which is supported by that of Mr. Goulton and Mr. Hulbert, who, as before stated, obtained 20 bushels of seed from 1 ton of straw.

The questions will be asked, what is the most suitable soil for flax? and what crop should it follow? With regard to the first of these questions, from all the information I can obtain, flax may be grown successfully on almost any soil, and in any climate. Every country of the civilised world appears to produce it. It is more extensively grown in Russia than in any other country, though it is largely grown in India, Egypt, and

America. I have been fortunate in making the acquaintance of Mr. James Goulton (above alluded to), of Ponder's End, Northampton Road, Middlesex, who has probably been the largest grower of flax in the United Kingdom. He tells me that he has grown upwards of 2000 acres of flax in one year, in Yorkshire, Lincolnshire, &c.; that he has grown it successfully 1000 feet above the sea-level, and not less successfully below the level of the sea; but he considers a "strong" soil produces the best fibre, and deep friable loam the most bulky crop. It will certainly grow fairly well on the chalk, and some twenty years ago it was grown to a considerable extent for a few years in North Wilts, until the factory at Calne stopped work, owing to the failure of the proprietor. There appears to be little doubt that any land in good condition, free from weeds, and in a finely pulverised state, in any part of the United Kingdom, will grow a satisfactory crop of flax; and Mr. Goulton gives it as his decided opinion, after forty years' vast experience, that this country can produce flax of equal quality of fibre to any that can be produced elsewhere, not excepting Holland and Belgium. What place flax should take in the rotation is a matter of opinion, and I am inclined to think of little consequence as far as the flax-crop is concerned, provided always that the ground works "kindly." In Russia it is usually grown after an old "lay." The land is ploughed deeply in autumn or winter, harrowed down, and the seed sown on the stale ground. I intend, as a rule, to plant it after roots fed off, where there is danger of barley lodging, and to take barley as the next crop. In Lincolnshire I am told that flax has been found a good preparation for wheat, and that the old idea of its being a very exhaustive crop is a pure delusion.

Enough has been said, I think, to prove that satisfactory crops may be grown, provided a good market can be found for the straw or *fibre*, should the grower determine to scutch his flax at home; for though in many parts of England a little flax has been grown for many years past for the sake of the linseed, it can hardly be worth any one's while to grow it solely for that purpose, or for consumption on the farm, though flax-straw makes the very best thatch. And this brings me to the point of importance, namely, to what extent is there likely to be a market for the straw? On the answer to this question must, I think, depend whether flax will be largely grown in this country or not. A certain agricultural newspaper, in commenting on this subject in the spring of this year, remarked, "First catch your paper-maker," which might be meant to convey that I had made a very good bargain with the manager of the Ely Paper Mills. Had the writer known Mr. Reed, and been aware of the business-like way in which

the Ely Mills are carried on, he would have been aware that the unsophisticated farmer was much the most likely to be caught. The Ely Paper Mills make one class of paper only, viz., news-paper, of which they turn out 75 tons, or thereabouts, weekly. To effect this, about 3000 tons of esparto-grass is used annually, at a cost of from 5*l.* to 7*l.* per ton, and 2000 tons of straw and other materials at various prices. If I have shown that flax can be grown at a profit of 4*l.* 10*s.* per ton for the straw, and 8*s.* per bushel, or even 7*s.*, for the seed, the British farmer will still want security that he will obtain a market for his produce before going into the business. Facts speak louder than words, and the announcement by Mr. Reed that he would be prepared to take 1000 tons of flax-straw, at 4*l.* 10*s.* per ton, during the ensuing season, should be pretty conclusive evidence that he finds it an economical substitute for esparto-grass; as a matter of fact, he would be prepared to take 2000 tons at the price, provided the quality were equal to what I have supplied. Now this is no spasmodic action on the part of Mr. Reed; he has arrived at his conclusions after very careful experiments, scientifically conducted; and as flax has undoubtedly proved a great success here, it is absolutely certain that other paper manufacturers will adopt it, or they will be driven out of the market. Hitherto Mr. Reed has simply used flax as a substitute for esparto-grass, to bring his paper up to a certain standard; it has not been used for making any special paper, for which from its marvellous tenacity it would appear to be peculiarly suitable; the full extent of its value as a paper-making ingredient is not, therefore, yet determined, but I take it as absolutely proved that, at the price mentioned, it is an economical substitute for esparto-grass in the manufacture of news-paper.

I am not in a position, for various reasons, to make an exact comparison of the relative values of flax and esparto-grass for paper-making; it would be extremely difficult to do so with scientific accuracy, and would be quite beyond the objects of this paper, which pretends only to deal with the matter broadly, leaving the more subtle points to be dealt with, if necessary, by experts. But it is admitted by Mr. Reed, and must be clear to any one, that, as far as *quality* of fibre is concerned, flax is far superior to esparto-grass; but esparto yields a rather larger proportion of fibre, it is of a far more yielding nature, and more easily and cheaply converted, requiring simply to be put into ordinary boilers without any further trouble (than to be picked over to extract the knotted portions) before being reduced to pulp. But with flax the treatment is slightly more expensive. The cost of picking certainly is saved, for in pulled flax it is unnecessary, but it has to be chaffed, or it would form ropes and be

impossible to deal with; and further, it has to be boiled under a pressure of about 80 lbs. to the inch for a considerable time before yielding up its fibre. What this extra expense amounts to I am unable to say; but it cannot, in my opinion, be of any great consequence, only it necessitates extra machinery (chaff-cutter and high-pressure boiler), the latter not always available in the paper-mills of the present day.

Is this a new discovery? will be the question naturally occurring. As far as paper-making is concerned, I believe it is entirely new. For certain kinds of paper flax has been used from time immemorial. The ancient Egyptians are said to have made paper from flax, and the waste from linen factories has for some time been made use of by paper-makers. But the use of the raw material, the separation of the fibre by means of boiling under pressure, is, I believe, quite new, and the honour of the discovery belongs to Mr. Reed; this is the secret of flax being now used for paper-making. The importance of this discovery appears to be considerable in its probable effect both on the paper-trade and upon British agriculture.

Assuming, as I think I am entitled to do, that flax at 4*l.* 10*s.* is a cheap substitute for esparto-grass, it would appear certain that in future it must enter largely into competition with that product; and that, assuming the price of esparto to be 6*l.* 10*s.* per ton, and that flax is equal to it in quality, if not superior (as I strongly suspect), the effect of its use will be to reduce the cost of esparto to 4*l.* 10*s.* per ton, which probably means driving it out of the market, or the price of flax will rise to a level with that of esparto. I believe the latter to be by no means unlikely, though probably the prices of both will be affected and assimilated.

Now it may be well to consider for a moment the extent and importance of the trade in esparto-grass—used, it will be understood, entirely in the manufacture of paper. The following figures show the amount and value of the imports of esparto in the years 1879, 1880, 1881:—

	Tons.	Value.
1879	162,014	£ 952,020
1880	190,891	1,368,307
1881	192,328	1,275,707

Equal to an average price of about 6*l.* 8*s.* per ton.

But prices for the present year are considerably higher, and in January averaged 9*l.* per ton. Assuming that flax took the place of esparto-grass only, it would require some 128,000 acres to supply the equivalent. Calculating on a crop of 30 cwt. per acre, the value of the straw at 4*l.* 10*s.* per ton only would amount to 864,000*l.*—a nice little sum for the British farmer to realise for flax-straw. But it is not only esparto-

grass that is imported; vast quantities of hemp, jute, pulp made from various kinds of wood, bamboo-cane, rags, straw, and many other articles are imported for making paper. At the present time (July) upwards of 3*l.* per ton is being paid at the Cardiff Mills for oat-straw from Belgium; can it be doubted that at the relative prices flax must be far the cheaper? or that flax must enter largely into competition with these far inferior articles? There appears to be at the present time a great desire on the part of the paper-makers to find a new fibre on which they can rely for a regular supply, for the supply of esparto-grass is somewhat precarious; and owing to the war in Tunis, to frequent disturbances among the Arabs, the monopolies granted to certain companies, and so on, the supply has not been regular or satisfactory. The present time therefore appears favourable for the introduction of flax, and to accomplish this the paper-makers must take the matter up, and put out offers to take so much flax at so much per ton, as Mr. Reed has done; let them do this for a few years until the crop is established, and there will be no further difficulty about the supply.

Paper-makers at present appear to be incredulous as to the low price, of 4*l.* 10*s.* per ton, at which farmers can afford to produce flax, and well they may be, seeing how much more money they have been paying for an inferior article. At the annual meeting of the Paper-makers' Association, held on May 9th, the subject of flax for paper-making was discussed, when the President remarked that "he was certainly under the impression that if any one could grow flax to a profit, it would be the cultivator who could 'rett' it, and get 40*l.* a ton for it as a textile fabric, instead of 4*l.* 10*s.* as a comparatively waste product. It seemed to him doubtful whether so expensive a crop as flax, which was available for the linen-spinner, could ever be produced to meet the requirements of the paper-maker."

At the same meeting another gentleman stated that "the cost of flax-waste was from 5*l.* to 14*l.* per ton. It was a delusion to suppose that straw-flax could be brought into the market for paper-making. For that purpose the material could only be the *débris* after the use of the straw as a textile material." And this in the face of the published fact that the grower has produced it, and found it a profitable crop at 4*l.* 10*s.* per ton, and that Mr. Reed has used it in considerable quantities, and is prepared to take one or two thousand tons this season!

It is undoubtedly a great question whether it will not be found economical to extract the best part of the fibre for linen, and use the inferior only for paper. This probably will depend in a great measure upon the kind of paper required, also

upon the quality of the flax. For instance, at Ely they make only news-paper, and here they require a strong, rather than a fine and expensive material. Flax is used sparingly, among a quantity of inferior ingredients, to bring the whole up to the required standard. In this case there can be very little doubt that the finer portions of the flax should be sold for linen-making, and the coarser portions only made use of for paper. But in the case of the manufacture of fine strong paper, for making which they are now paying 20*l.* per ton for half-rotten old sails, it would probably be economical to use the best of the fibre as well as the inferior; but this is a matter of detail, and it will be sufficient to know that, should it be found profitable to use any portion for linen, it certainly will have a tendency to improve the price to the grower.

Hitherto flax has generally been grown either for the fibre alone, or for the seed alone; for instance, in Belgium they grow almost entirely for the fibre; in Central Russia the fibre only is cared for; while in Southern Russia the seed only is accounted of value. It has probably been owing to the difficulty of finding a good market for both fibre and seed that has caused flax to be so little grown in this country. But this new demand combines the two, allows full advantage to be taken of the seed-crop, and at the same time affords a fairly good market for the fibre.

But there are probably other good reasons why flax has not been grown more. Wheat was formerly a very paying crop: it is easy to manage, grown without much difficulty, easy to harvest, and very convertible into cash; and at 7*s.* or even 6*s.* per bushel, with good harvests, was the farmer's sheet-anchor, and often pulled him through when the more precarious spring crops failed him. Moreover, the farmer found that he required a special education to produce a good marketable flax-fibre, that its preparation greatly interfered with his other work: in short, that it was a special business, and, like a combination of farming and market-gardening, it did not answer, and could only be made to answer by making a specialty of it. Yet Mr. Goulton did well at the business, notwithstanding the fact that he had to pay from 5*l.* to 8*l.* an acre for the land, and to take it in plots of from 20 to 100 acres, at distances varying up to 100 miles from his place of business; and, to use his own expression: "If I could have sold my waste for paper-making, I should have been as rich as Sir Titus Salt."

Then, again, it was formerly the usual thing for landlords to prohibit the growth of flax, from an erroneous impression that it was an exhaustive crop for the land, and also from the laudable idea that it was their first duty to produce as much food as possible for the people, as will be seen from the following extract

from the 'Agricultural Magazine' of 1806, vol. xiv., signed "W. W., Hants:"—"Pastorius says: 'It has been confidently asserted that we might raise flax and hemp enough in this country for our own consumption; but if we could, I contend it would be very injudicious husbandry, because these articles would require land which would produce large quantities of corn, an article of infinitely greater importance, and one of which we cannot raise supplies enough for our necessary consumption.'

"The above remark is certainly just; we had infinitely better come short of the materials of clothing than of those for eating, the first of all our wants, and it is obviously of far greater importance to reduce the price of the latter.

"Why, by whom, and for what special reasons, our culture is arbitrarily limited and restrained, and so much of the rich soil of Britain, amply sufficient both in point of quantity and quality to produce enough of both commodities, not only to supply our home demand, but even to make us an exporting instead of an importing country, is important matter of inquiry for Britons. Under a system of free and general culture, both hemp and flax would most beneficially make part of our usual course of crops on all well-drained strong lands, and on certain fertile descriptions of light land. These articles, in fact, make a good preparation for wheat, and in times of low price for the latter, which I have seen, have been occasionally a very advantageous change of crop, bringing me a greater return than I could possibly have reaped from the best crop of wheat. Indeed, I am speaking of land which I had in hand, although at the same time, by a strange incongruity, the tenants of two farms which I let were restricted 'from the culture of both hemp and flax,' and from paring and burning. These leases were copied in routine from the originals under my grandfather, and it is but of late years that I have consented to the expunction of the clauses against paring and burning, growing hemp and flax, and the obligation to summer fallow.

* * * *

"I shall conclude this subject, sir, with a short extract from the late volume of communications to the Board of Agriculture. Page 188 of said volume, Mr. Smith, of Chebness, Oxfordshire, gives his opinion as follows on the permission to grow flax:—

"'In respect to the course of crops to make the most of clayey land, flax should be your first crop; but this I know by experience many, nay, I may say all, landlords will agree against; but I have had the pleasure, by experience, to convince them they are wrong; for by sowing flax, and that being well attended to, your land is excellently prepared for wheat, your tenant has in the flax an excellent manure for all his lattermath,

upon which his flax is laid; he has a rich supply of seed to feed his cattle; he has abundance of labour for the poor, and at last has from a good crop from 10*l.* to 15*l.* per acre to put into his purse to enable him to be a good tenant, and to give both land and landlord every satisfaction required.' "

Belgium grows flax largely, and sends her fibres here in large quantities; in fact, flax is to Belgium what wheat was formerly to England, viz. her most valuable crop—the crop for which the Belgians particularly farm, 140,000 acres being grown annually, for much of which, as Mr. Jenkins shows, the "flax-farmer" is content to pay a rent of from 8*l.* to 11*l.* per acre, find seed and manure, and bear all cost of harvesting the crop.

All nations grow flax excepting England:—

	Statute Acres.
Austria	218,042
Belgium	140,901
France	162,099
Germany	329,363
Hungary	27,048
Holland	44,114
Italy	200,356
Ireland	159,534
Russia	2,000,000
Sweden	33,639
United States (about)	400,000
Great Britain (in 1880)	8,985
And last year only	6,410

For many years England has been paying the foreigner large sums of money for fibres, linseed, and cake that might equally well be grown at home; and it seems strange that the Briton, so sorely in need of agricultural prosperity, should allow the foreigner to supply us with productions which to him are found about the most profitable he can produce. Even in that part of Ireland where flax is grown and manufactured, peace and prosperity are to be found. Surely English farmers can grow flax, and manage it as economically as the Irish; and I see no reason why we should not be a match for the Belgian, or any other farmer, in this matter.

The following table shows the extent of the foreign fibre trade:—

Imports in 1880.	Value.
Flax dressed and undressed	£3,544,214
Tow and codilla of flax and hemp	643,647
Hemp, &c., dressed and undressed	1,781,730
Jute	4,018,800
Esparto, and other like materials	1,642,903
Rags	451,782
	£12,083,076

Then, again, we paid the foreigner :—

		£
For linseed in 1880	.. ..	4,260,000
And for oilseed-cake	.. ..	1,242,834

Before allowing our good wheat soils to become bad pasture, is it not worth while trying flax, which offers a fair prospect of being as remunerative as wheat at 7*s.* per bushel (which price would thoroughly satisfy the most disconsolate of wheat farmers), and keep some of the money in this country which is now enriching the foreigner?

The demand for flax for paper-making seems more likely to find favour with the farmers of this country than the demand for fibre for the linen trade, because the trouble attendant on the preparation, and the ignorance that must necessarily prevail as to the proper management of a completely new and complicated business, together with the difficulty of finding the best market, and the uncertainty as to the value of the article produced, combine to form a strong bar against individual farmers taking up a new track of this kind. But should a company of landlords and farmers take the matter up (and the present seems a very favourable opportunity for doing so), there appears to be every prospect of success; for there can be little doubt that the growth and preparation of flax for linen, where carried out on the right principles, as in Holland, described by Mr. Jenkins in the thirty-fourth number of the 'Journal,' page 430, the result must be highly satisfactory. But I take it that the first principle of success must be that the farmer has simply to grow the flax (perhaps thresh it) and deliver it to the manufacturer, who must undertake the retting, scutching, and everything else connected with the management of the fibre. It is enough for the farmer to produce the raw material, and more than that he will not do; but, ensure a fair price for the raw material, and enough flax will be grown in this country to render us independent of any foreign supply.

Bearing upon this question, the following letters from Mr. Thomson afford information that will assist in forming an estimate of the results of flax-farming from a linen point of view :—

Extracts from Mr. THOMSON'S *Letters.*

"Ligoniel House, Belfast.

"The style of scutching, of which results are here noted, is that known as ordinary *mill* scutching, in contradistinction to scutching by hand, or by any of the so-called patent processes.

"With Irish farmers it is very difficult to arrive at exact details as to weight, produce, &c., of their flax crops, as very few of them take the trouble of weighing the flax-straw before scutching. The following is the information you desire in the form in which I intend to give it in my book.

"*For one English acre.* Seed—according to nature and preparation of the soil, &c., 1½ to 3 bushels—usual average 2 bushels; produce of dry or win-straw varies with the culture, quality, and seed, season and setting, from 20 to 50 cwt., recognised average or standard of fair crop being from 30 to 40 cwt. Yield of fibre (affected by the points already mentioned, and in addition by its manipulation in the scutching process) ranges from 3 to 10 cwt., usual result being from 4 to 5 cwt.

"The respective averages are therefore: for fair medium to good flax-seed, 2 bushels; win-straw, 35 cwt.; fibre, 4½ cwt.—a yield from the dry straw of 12·86 per cent. An exceptional case was where, from 3 bushels of seed to the English acre, in a good season—weight of straw not recorded—85 stones (14 lbs.) or 10 cwt. 2 qrs. 14 lbs. of fibre was produced.

"*The cost of scutching* goes on the principle of 'payment by results,' varying with the number of scutch-mills in the district, the large or small yield of straw in a season, probable quality of fibre, and the name the scutcher has for good or bad scutching. From 1*s.* to 1*s.* 6*d.* per stone (14 lbs.) of the fibre produced—average, about 1*s.* 2*d.*, less the value of the *scutching tow* (dirty and short fibre taken off during the scutching process), about 2 to 2½ cwt. from an English acre produce of win-straw; value of the scutching tow, 3*s.* to 4*s.* 6*d.* per cwt.—average, 3*s.* 6*d.*

"*Yield of fibre from straw.*—This depends on the growth of the flax, and to proper attention having been paid to retting, a healthy growth and good retting giving of course a much better result in fibre from a given weight of straw than where one or both of those points have been missed; a short, poor, or sticky growth on the one hand, and under or over retted flax on the other, will, separately or combined, cause a yield of say only 6 per cent. of fibre, when from a healthy grown plant and good retting a yield of 17 to 20 per cent. might be procured.

"The scutching also is a vital point, which has been, and is still, sadly—too often willingly—neglected. The farmer wants weight, often forgetting that the scutcher gives him this at the expense of quality, and also of ultimate profit; while for the scutcher, the more weight the better the flax pays. Compared with French, Dutch, and Belgian flaxes the style of handling and scutching Irish flax is in eighty cases out of a hundred simply abominable, and can never well be otherwise till the farmer's interest terminates in the flax when pulled, the after-processes of retting, scutching, &c., being carried on by a specialist, having not only the knowledge but the time to carry out these processes successfully. By some of the patent scutching processes (Schenck's, Watt's, &c.) the yield of fibre from straw runs from 6 to 14, 17, 20, and even 25 per cent.—average, about 16 or 17. In hand-scutching the yield is still greater than by any of the other processes for the same straw, but in Ireland this arises too often from insufficient scutching, a good deal of straw being left sticking on the fibre, in consequence of which hand flax is generally worth from 4*l.* to 7*l.* per ton less than milled (or even patent scutched) for the same straw—the extra weight, however, sometimes more than compensates (especially in poor flax) for the difference in price.

"The fibre of all classes and prices of flax is spun into yarn (either in the form of 'line,' dressed flax, or tow), the scutching tow is again scutched at the end of the season and sold as 'rescutched tow,' to be spun into yarn. The poorer qualities not worth rescutching are sold for paper-making, and are worth from 3*l.* to 18*l.* per ton, according to quality—average value of paper-making wastes, 4*l.* to 4*l.* 10*s.* per ton.

"Having given you the information you ask for on the acre standard and in a general way, I will try to reduce it to your particular standard of the ton of straw.

"20 cwt. of win-straw would give in scutching :—

(*a*) Best quality,	3½ cwt. fibre,	1¼ cwt. tow,	and	15¼ cwt. waste, &c.	
(*b*) Medium,	2½ „ „	1 „	„	16½	„
Low,	1½ „ „	¾ „	„	17¾	„

"Cost of scutching 20 cwt. of win-straw :—

	£	s.	d.
(*c*) Best fibre, yield 28 stones (14 lbs.), at 1*s.* 2*d.* ..	1	12	8
Less 1¼ cwt. tow, 3*s.* 6*d.*	0	4	4½
	£1	8	3½

	£	s.	d.
(*c*) Medium fibre, yield 20 stones (14 lbs.), 1*s.* 2*d.* ..	1	3	4
Less 1 cwt. tow, 3*s.* 6*d.*	0	3	6
	£0	19	10

	£	s.	d.
(*d*) Low fibre, yield 12 stones (14 lbs.), 1*s.* 6*d.*	0	18	0
Less ¾ cwt. tow, 3*s.*	0	2	3
	£0	15	9

Values of fibres, present season's prices, 1881–82 :—

Best fibre,	9*s.* 6*d.* per stone	= 76*s.* per cwt.,	or £76 per ton.	
Medium,	6*s.* 6*d.* „	= 52*s.* „	£52 „	
Low,	4*s.* 6*d.* „	= 36*s.* „	£36 „	

"(*a*) and (*b*). There might be actually more tow yielded in these two cases than I have noted, but the quantities stated would be about what the scutcher would be willing to allow as being saleable or fit for rescutching.

"(*c*). The rates of scutching are taken the same for these two lots, the 'best fibre,' though yielding more, would need greater care, and take more time per stone to scutch.

"(*d*). Rate of scutching, 1*s.* 6*d.* per stone. This would be so when the farmer wanted his poor flax extra well-handled ; if he considered the extra care would not pay, he could get it scutched (run through quickly) at the ordinary rate of the milling, 1*s.* 2*d.*, the yield of fibre being of course less.

"(*e*). The 'waste, &c.,' goes to the scutcher : that is, the straw, woody matter, &c., which in scutch-mills driven by steam are used as fuel for the boilers."

Letter No. II.

"I append a tabular statement, showing acreage and yield of flax in the different European countries, which I had intended to note in my last letter. The return is for the year ending 31st of December, 1880. The yield of fibre per acre in Ireland, you will observe, is *considerably less* than what I noted in my statement ; but going into farming scientifically, and with proper attention to the retting, scutching, &c., I believe my estimate would turn out a fair one. However, here are the *actual averages*, and in a paper like that you are writing it would be better to stick to the actual than to the probable results :—

Countries.	Under Flax. Statute Acres.	Average yield. Stones (14 lbs.) per acre.	Total tons Fibre.
Austria	218,042	33·14	45,162
Belgium	140,901	33·59	29,580
Denmark	6,292	20·00	787
Egypt	15,000	20·00	1,875
France	162,099	36·49	36,969
Germany	329,362	27·90	57,432
Greece	957	20·00	119
Great Britain	8,985	24·89	1,398
Hungary	27,048	31·36	5,301
Holland	44,114	26·79	7,386
Italy	200,356	18·33	22,953
Ireland	157,534	24·89	24,508
Russia	2,000,000	20·00	250,000
Sweden	33,639	20·00	4,205
Total: Europe, including Egypt	3,344,329	23·33	487,675

"Referring to your inquiry as to the economy of using the better portion of the flax for fibre, and the poorer quality for paper-making, my opinion would be against such a proceeding in your case especially, for the following reasons:—

"1. You sow lighter for seed and straw than for fibre, viz. 1½ bushel for the former, and 2 or more bushels for the latter object, per statute acre. This lets the sun and air freely at your plants, making them stronger, hardier, and more resinous in composition, good for a large yield of seed and straw, but coarse, brittle, and "hempy" in fibre.

"2. If you sow for fibre, to have a good article you must to a certain extent sacrifice the seed, that is, you must pull before the seed is thoroughly ripe if you want fine silky fibre, otherwise your fibre will be hardening and coarsening while you wait for the seed to ripen thoroughly.

"3. In your district you have not the arrangements and appliances at hand for good retting and scutching; if you had to take your straw any length to the scutcher, the cost of carriage on this great gross weight would overcome the profit.

"4. You are not near enough a good flax market; this I take to be true, theoretically and geographically; but perhaps you know of outlets near enough at hand.

"In my opinion, flax for the *straw and seed*, and flax for the *fibre* would constitute more or less two distinct businesses, proceeding by different methods to obtain the best results in each case. Of course if you (*a*) have a purchaser within reasonable distance, (*b*) care to go to the expense of establishing a retting and scutching establishment (making up your mind for the losses incident to first experiments in these processes), and (*c*) sow heavily for fibre, counting less on profit from seed, I believe in the end the venture would pay well, and be a first-class thing, not only for your own neighbourhood, but for the whole country.

"Mr. J. B. Edmonds, of Stone House, Plymouth, Mr. Warnes, of Trimingham, Norfolk, and others have gone extensively into flax-fibre business. Mr. Warnes especially made it a main point on his farm, brought over retters from Belgium, scutchers from Ireland, and produced some of the best flax used in the Leeds-mills at the time he was in the business, fifteen to twenty-five years ago.

"The acreage under flax in Great Britain in 1880 analysed was as follows:

England	8788 acres.
Wales	15 "
Scotland	182 "
	8985"

I find in the 'Rural Cyclopædia' that in 1846 Mr. Sharman Crawford, M.P., produced one-third of a ton of fibre per acre, and the Mr. Warnes quoted by Mr. Thomson, when growing only for seed, found flax an equally profitable crop as corn; and that several growers about the year 1845, in Suffolk, Norfolk, and Essex, grew from 20 to 29 bushels of seed per acre; and that Mr. Negus, of Downham Market, grew 32 bushels per acre.

I contribute this paper in the earnest hope and sincere conviction that British farmers and the manufacturers of linen and paper should at once turn their serious attention to the production of flax in this country, and that by so doing the restoration of agricultural prosperity would be considerably assisted.

Postscript, *September* 11*th*.

My crop of flax is now just ripe, and though planted late, is on the whole a very satisfactory crop, and will compare favourably with my corn crops. Notwithstanding the incessant wet, the crop has done fairly well, though I observe that it is best on the driest ground.

The first piece of 10 acres, after peas, manured with a fair dressing of farmyard-manure, was planted early in April; but owing to the over-anxiety of the bailiff to get on with the planting, and his want of experience in flax-growing, the seed was planted before the ground worked kindly; a heavy fall of rain came immediately after, making the land hard on the surface; innumerable sand-weeds at once made their appearance and, in spite of hoeing, spoiled the crop, which will not make more than 10 bushels of seed and 10 cwt. of straw per acre: this bad return is the result of mismanagement, and nothing else. The next piece of 20 acres, after swedes fed off with fattening sheep, planted in the first week of May, is a fair crop excepting in a wet corner of the field, and will, I think, produce 30 cwt. of straw and at least 20 bushels of seed per acre.

The next piece of 10 acres, planted in the second week of May, after seeds mown in 1881, manured with a moderate dressing of farmyard-manure, broken up and attempted to be cleaned in the autumn, finished off in the spring, is a magnificent crop, quite 2 tons of straw and probably 25 bushels of seed per acre.

The above are grown on an off-lying farm at Portskewet, near Chepstow, the soil being a sandy loam on gravel similar to this.

At this place I have 22 acres grown after wheat (following clover), manured with 5 cwt. of damaged decorticated cotton-cake per acre, planted early in May. This is a good level clean crop, and apparently better seeded than any I have hitherto grown. I estimate this crop at 30 cwt. of straw, and 24 bushels of seed. The remaining piece I have to mention is 8 acres, grown half after barley, half after potatoes, the former manured with 1½ cwt. of nitrate of soda per acre, the latter with farmyard-manure. This was planted about May 12; the crop is equally good all over, about 35 cwt. of straw, and 20 bushels of seed, as near as I can judge. Many of my friends have grown flax this year, and from most of them I hear that they are well satisfied with the appearance of the crop; though in one notable instance a similar failure to the one above mentioned has occurred, from the same causes as led to my own failure, viz. planting too early, and before the land had lain long enough to allow the annual weeds to germinate and be destroyed. As the result of another year's experience, I am more than ever persuaded that it is a mistake to plant flax very early, that a fine warm seed-bed is most desirable, that annual weeds should be most carefully destroyed before planting, and that I must grow at least 100 acres next year.

XXV.—*Deerfoot Farm Centrifugal Dairy.* By E. Lewis Sturtevant, M.D., Waushakum Farm, South Framingham, Mass.

[Abridged from the Report of the Agricultural Department of the United States for 1880].

Perhaps it is safe to say there is no farm in America which can present so much that is novel and useful to the observer as Deerfoot Farm, Southborough, Mass., the property of Mr. Edward Burnett. It is not amateur farming that is to be seen here, but real "fancy" farming, the use of intensive conditions, the employment of abundance of labour, and the availing practically of every new idea adapted to the conditions that promise improved profits.

This farm covers about 300 acres, of which some 100 are tillable. Its specialties are fancy pork, gilt-edged butter and cream, family milk, skim-milk, and buttermilk.

To meet these requirements much money has been expended for conveniences, and the farm partakes in its management of

the character of a factory. The swine are grown on the place, or to order, are slaughtered as pig pork, and are presented for sale in small, neat, and attractive packages, which include "Deerfoot family pork," "Deerfoot hams," "Deerfoot bacon," "Deerfoot jowls," "Deerfoot pigs' feet," "Deerfoot sausages," "Deerfoot lard," &c. From the pens in the piggery, through the slaughter-room and packing-rooms to the market, there is the most precise cleanliness, and the wise use of all the advantages that well-constructed machinery, moved by steam-power, can offer. In 1879 the number of pigs slaughtered was about 1500, of an average weight of 175 lbs., the extreme weights of carcass being 140 and 250 lbs.

We, however, do not propose to describe this farm and this farming in detail, but to confine ourselves to the presentation of the dairy branch, which in like manner is worthy of attention from its development and from the novelty of its processes, for here are in use the only centrifugal milk machines, on other than an experimental scale, in America; and the skilled thought of the experimenter and the machinist have combined to produce the results best fitted for the handling, care, and manufacture of the milk.

The foundation idea which underlies this kind of farming is that there is a large discriminating public, who desire to purchase the best articles of the class, and who are willing to pay an increased price in order to secure perfection and uniformity of supply on their tables. Hence an expenditure may be justified in order to secure purity and cleanliness of product, attractiveness of packages, and such a sameness of quality that the brand stamped thereon shall justify confidence.

Milk is a very perishable commodity; it is quick to receive taints; it is readily influenced by surrounding conditions; it can only be retained in its best condition for a limited time through the exercise of the greatest care. It varies in character with the breed of cow, with the individual cow to a less, yet still marked extent, and responds in its chemical and physical condition to changes within the cow. Its chemical composition shows it to be an emulsion of fat globules in a solution containing water, sugar of milk, casein, albumen, and salts. Its physical conformation is the fat globules which originate through the cell action within the ultimate follicles of the udder glands, and are formed by the proliferation and separation of, accompanied by a fatty change of contents in, the cells which line the interior of the milk glands. These fat globules are extremely minute, varying in size from the merest point to the comparatively large globule, measuring often $\frac{1}{2700}$ of an inch, exceptionally single globules as large as $\frac{1}{1500}$ of an inch in diameter. At one time

in the history of their genesis they formed a portion of the cows as cells, and hence it would be expected, as indeed observation has proven, that they partake in a certain degree of the changes which influence the cow. Hence a starvation of the cow, or any course which interferes with cell-growth in the animal, is perceived in the udder glands, through the diminution of the cell-growth there, as evidenced by the deficiency of the completed fat globules in the milk. We also perceive that as various kinds of food influence growth-development in the cow, i.e., some foods have a greater fattening action than other foods, so change in the character of the food may be seen in the fat globule in the milk. Thus, the feeding of bran or shorts has a distinct influence in diminishing the size of the globule; the feeding on corn meal, a distinct effect in influencing uniformity of size in the fat globule. We also perceive an influence over the globule occasioned by the condition of the cow in relation to calving. When parturition has just taken place, and the colostrum condition of the milk exists, the globules are, many of them, aggregated, and show a great variation in size, and are often not free but attached to the membrane which has become disrupted through the intensity of the action accompanying the commencement of the milk flow. This colostrum has a putrefactive tendency. A little later the colostrum period has ceased, the flow of milk is abundant and normal, the shedding of the globules is complete, yet there is a striking disproportion in their size. The action connected with their growth is still irregular. As time increases the globules become more uniform in size, and there is a less disproportion between the largest and the smallest.

There is also to be recognised a difference in the globule accompanying the breed of the cow. In the Jersey breed the average size is larger than in the Ayrshire or Holstein breed; in the Ayrshire breed less uniformity of size, and more of the smaller globules, entitled granules, than in the Jersey or Holstein breed; in the Holstein breed, a small globule, quite a uniformity of size, and few granules.

These globules have different churning reactions. The globule of the Jersey cow is more readily broken than is the corresponding sized globule from the Ayrshire cow, and is more readily acted upon by the changes resulting from the keeping of milk. The larger the globule, other things being equal, the quicker the churning, and the better the quality of the butter in respect to the grain. Thus, of cream taken from milk at intervals of twelve hours, the first skimming, which contains the larger globules, produces butter of better quality than does the cream of the second skimming. The seeming explanation of

this fact is the reasonable, although as yet unproven, view that the butter fats exist in a certain relation in the globules, and it is this natural relation which produces the so-called grain of butter: when this relation is disturbed by overworking the butter, this grain, so much desired, becomes lost. In the larger globules this arrangement is coarser and more distinct, as shown in the aggregate butter, than in the smaller globules. This view of the relations of the fats is, however, disputed by some, as it is claimed that in oleomargarine factories butter and tallow melted together and allowed to fall in a small stream into ice water takes on a condition which gives to the completed product a fine grain of high quality.

The fat globules again have a lower specific gravity than the fluid in which they float; they are invested in a membrane, probably animal in its origin, which is heavier than the fatty contents. Hence, as the different specific gravities of the envelope and the contents vary greatly as the diameters change, the large globules are specifically much lighter in relation to the fluid in which they float than are the smaller globules, and they accordingly rise with far greater rapidity towards the surface.

In addition, these form-elements of the milk have a different specific heat than the unformed fluid elements, and accordingly quick changes of temperature do not warm or cool the fat globules, and thus affect their specific gravity, in the same proportionate time as the fluid portion is warmed and cooled.

Millon and Commalle distinguish a casein suspended in milk, and another dissolved in it. This relation appears to have been generally overlooked by students on milk, yet I am disposed to believe that the microscope discovers many granules of this casein suspended in skim-milk, and these are often, perhaps, confounded with fat globules of such small size that their envelope loads them down so that their tendency is to remain in suspension, or to fall rather than to rise. An analysis of the scum which collects upon the walls of the drum of the centrifugal machine, as analysed by Lawrie and Terry, shows casein there at the point of greatest pressure to the amount of 25·49 per cent. As casein has a greater specific gravity than the other constituents of milk (1280, according to Professor Goessman, in a private letter), all that casein which has form would naturally seek the circumference when put under the influence of centrifugal force. Moreover, if skim-milk be taken and diluted with a little water, the microscope will detect more granules in the lowermost layers, after it has stood quietly for some time, than in the upper portions. It is but proper to state, however, that analyses made for the purpose of this paper of the skim-milk from the interior and exterior of the milk as occupying the machine, not, however,

including the outer layer where the scum accumulates, show a composition as nearly identical as can be expected, and no increase of casein, a fact which, while not opposed to this view, yet cannot be considered confirmatory.

The morphological relations of milk are those which concern us the most in our studies into the effect of centrifugal force upon this product of the cow, and hence the necessity of these preliminary observations bearing upon this form-character. In this aspect the chemical relations are of less importance. We, however, would summarise briefly a few facts that are conclusively established, and a few other circumstances which are as probably true.

There is no relation between the percentage of cream and percentage of butter that can be made therefrom. Hence, it is an absolute fact that the cream per cent. does not indicate the butter quantitative quality of the milk. The appearance of the cream does, however, afford us strong ground for a presumption that the denser the cream the more the butter that it will make. A cream percentage of 20 per cent., if by a constant series of jarrings it be reduced to 10 or 12 per cent., will make the same quantity of butter in its new form as in its old form.

The fat shown by analysis to exist in milk does not all appear as butter when the milk is churned. Churning is a physical process and acts upon the larger globules only. Hence, of two milks, showing like figures to analysis, the churn will separate more butter from one than the other, especially if the milks be from two distinct breeds of cows.

There exists in milk, under normal circumstances, a proportion of albumen varying from one-third to three-quarters per cent. There also exists an undetermined proportion of what may be called mucus, the wear and tear of the cow under the action of milk formation.

The casein of milk from different races has distinct properties. In human milk, when coagulated and dried, it possesses a friable character. In the milk of the bitch it does not become viscid and horny on drying. In cow's milk it becomes viscid and horny on drying. It also varies in character in the milks from different breeds of cows, being more horny on drying in the milk of the Jersey than in that of the Ayrshire breed. Rennet precipitates the coagulum with greater or less ease in different milks, as do also mineral acids.

The importance of alluding to these considerations will appear when we come to describe and discuss the practical relations of centrifugal force to the dairy.

Deerfoot Herd.—The foundation of the milk industry is the cow, and hence we must commence by describing Mr. Burnett's

cattle; and as the character of cattle are influenced by breeding, and as it is probable that the possession of the Jersey breed has had much influence in determining the direction towards the present outcome of Mr. Burnett's system, we must devote a few pages to his herd—the Deerfoot herd.

This herd was established by Dr. Joseph Burnett, in 1854, the animals coming from the Taintor importation, through Dr. Morton, of ether-discovery fame.

The object Dr. Burnett had in view was to secure richness of quality of milk and an abundant flow. To this end he carried his selections and his breeding. When the herd came into possession of Mr. Edward Burnett, in 1871, the same system was continued. No attention was or has been paid to solid colours or fancy points, but the whole desire was to obtain cows of large average size for the breed, long and rangy bodies, largely developed udders and escutcheons, and especially to secure udders of the Ayrshire type, but with large teats. The results that are now reached indicate clearly the wisdom of this course. There is now that uniformity in the herd which illustrates successful breeding. The colours are a dark grey; the size large for the breed; the head fine; the horns small and of Jersey texture and quality; the neck slim; the body long; the hips and flanks broad and deep; the carcass heavy in the rear, and giving an impression of lightness forward; the udder capacious, extending well forward, rather flat on the sole and well teated; the escutcheon-marks well developed and well placed.

These cows mature early and continue their milk flow for a long time from calving. They are deep milkers, as the records which we present for the past seven years prove; indeed the quantity of milk is very large, and disproves the frequent assumption that the Jersey cow cannot be a large milker. The milk is of rich quality, the herd trials giving a range of 1 lb. of butter to from 17 to 21 lbs. of milk, according to season, and other adventitious circumstances, under the ordinary methods of butter making; and 1 lb. of butter to from 16 to 20 lbs. of milk, with the centrifugal process of separating the cream. The butter is of high colour and quality, and for many years has been of the "gilt-edged" type.

It is well to note that these are statements of herd trials, including all the cows in milk, and do not apply to the especial performance of any one cow.

Since 1873 a careful record has been kept of the milk yield of each cow in the herd, and I have taken these yields from Mr. Burnett's books, and the averages given below include every registered Jersey in milk during the year, and is rather below the real yield as including the young heifers, some of which

calved towards the close of the year in which their first yield appears.

This course of figuring has something to do with the inequality of yields which appear in different years, but the character of the season and the times of calving, and other incidental circumstances, have also to be considered. For the purpose of comparison I append the yield of the Waushakum herd of Ayrshires for the same years, premising that as a general rule for these Ayrshires of mine, either no, or but little, grain has been fed, and no soiling crops have been grown.

Years.	Quarts per Cow of Deerfoot Herd (Jerseys).	Quarts per Cow of Waushakum Herd (Ayrshires).
1872	..	2812
1873	2050	2528
1874	2377	2633
1875	2215	1901
1876	2712	2326
1877	2475	2466
1878	2404	2160
1879	2726	1903
Average for seven years ..	2423	2341

In explanation, we would say that the high price received for butter encouraged Mr. Burnett to increase his milk yield to the highest point, while the low price of milk encouraged me to obtain no more from the Ayrshires than they would give under the ordinary keeping of pasture in the summer, and hay and corn stover in winter. The value of these figures will be better apprehended when it is realised that the average yield of herds in the best dairy regions of New York is not in excess of 1300 quarts per cow; the average yield of superior herds in the same region is not in excess of 1800 quarts per cow; and the highest possible average yields of the best herds is not in excess of 2300 quarts for the best dairy regions. Whatever is more than this comes from the diffusion of thoroughbreds.

Nor will it be proper to assume that this herd yield applies generally to the Jersey breed. In the absence of figures to the contrary, we may say that it is so exceedingly exceptional that it has been brought about in this one case only, and this through most attentive care to breeding and the most rigorous series of selection.

While the Ayrshire results may be considered as of true breed significance, these Jersey results must be esteemed as of herd significance only. The Ayrshire cow is a large milker through

race inheritance; the Jersey cow is a large milker only through individual inheritance, and Mr. Burnett's figures have the important significance of directing attention to what the art of man can accomplish and to the capabilities of a breed for dairy purposes.

The Jersey cow gives a milk peculiarly adapted for butter making, and usually, but not universally, rich. Thus Dr. Waller found the milk in one Jersey herd to vary from 2·92 per cent. of butter fat for one cow to 6·50 per cent. of butter-fat for another. The Ayrshire cow presents like variations, but a milk not physically as well adapted to butter manipulation, but better fitted for cheese.

These physical relations have an importance which the use of the centrifugal machine must ultimately bring into a recognised practical importance, as does even now the chemical constitution of milk receive recognition by the practical man.

There are some individual yields in the Deerfoot herd which are deserving of record. We present those of four cows of which we have the record for the longest time:—

Years.	"Pink 3rd."	"Pink 4th."	"Susie."	"Mab."
	Quarts.	Quarts.	Quarts.	Quarts.
1873	2594	2076	1988	1950
1874	3118	2566	2298	2463
1875	3348	3143	2922	3028
1876	3922	3879	3476	3384
1877	3827	3895	3576	2991
1878	3660	2820	3495	2978
1879	3130	2210	4524	3935
Average for seven years	3271	2941	3182	2933

We call attention to these figures, as they apply to the only Jersey herd, so far as we know, which has ventured to publish its figures as a herd, and they have indeed a public value.

Care of the Cows.—The milking time is at 5 A.M. and 5 P.M., and the greatest regularity is sought. About eight or nine cows are considered sufficient for one milker. In summer the cattle are pastured, but driven to their stalls to be milked and to pass the night. They here receive some feed, and are consequently always quiet and easily herded. In the stable they are bedded on sand, according to the custom in this locality. They are carded regularly, not only for the sake of looks, but in order to secure that cleanliness which is such an essential condition in all that relates to the procuring and handling of milk. The stables are frequently whitewashed, and no dirt or litter is allowed to remain.

The Feeding.—We shall here allow Mr. Burnett to speak for himself:—

"The essentials to produce the best results are good cows, good feed, regularity, cleanliness about the stables and dairy, and a thermometer. I will give you my own method of feeding, and in so doing those dairymen who aim at *quantity* will realise that we are shooting at different targets, for with me quantity is secondary, quality being the greatest desideratum.

"Our finest butter is obtained in early summer, when the pastures are sending forth their early, sweet, succulent grasses, and we depend entirely upon them; but when these begin to fail, about mid-summer, I begin to feed wilted clover and a small quantity of grain, increasing as the season advances, unless the pastures are unusually good. I cut all my grass early, beginning by the 5th of June, and generally get a good second crop, thus trying to have an abundance of rowen hay. When in winter quarters I begin feeding at about 5.30 in the morning with hay, a little jag or wisp at a time, not so much but what the cows will eat it up clean. Then, after milking, the grain —from three to six quarts, according to the cow—consisting of two parts of Indian-meal and one of shorts or bran; or feeding entirely on ordinary cob-bage (corn and cob ground together). After this, more hay, which lasts until about 9 A.M. I begin again at 3 P.M. with a little hay, followed by roots (mangolds) cut fine, a bushel being divided between three cows; then more hay again, which lasts them until about 6.30 P.M.

"I maintain that if more shorts are fed than are necessary to counteract the heating quality and condensed richness of the corn-meal, it deteriorates the butter. During last March (1879) I saw this illustrated, being called upon in Boston to examine some butter from one of the finest dairies in the State, and which was troubling the dealer who sold it. He said it was negatively good; nothing could be said against it, yet mighty little could be said in its favour. It seemed to lack that fine nutty flavour so necessary to fresh butter that commands over 40 cents per pound. I said at once, upon tasting it, 'Too much shorts, and not enough corn-meal.' He answered, 'Just what I thought, but didn't dare to say so until it was confirmed.' In less than ten days the butter from that dairy was improved."

Manipulation.—There are two sources of supply for the milk, the home herd and that furnished by the neighbouring farms. The milk of the morning and the evening is kept separated. The morning's milk from the home herd is poured from the milk cans into a large cooler, and is thence, after being cooled, bottled for market as new milk. In summer it is shipped at 7 P.M. The cooler which receives this portion is a large metal cylindrical vat, of the capacity of 150 gallons. Within this is suspended a box containing ice, and attached to a lever, so that motion can be communicated to it in case the cooling is desired to be hastened, or a sort of propeller which keeps the milk in movement. As soon as the temperature is reduced to 50° the milk is drawn in successive portions into a pail, and thence poured into the bottles, which, after being corked securely, are transferred in the frames to the water refrigerator, as it may be called, where they remain until shipment.

The milk tank, with its cooler which receives the milk from the upper floor, is suspended at a convenient height on the

elevator, and by means of a faucet delivers the milk into the pail which is used to fill the bottles. The bottles are handled in wire frames which hold twenty, and these frames are transferred to the water-refrigerator, where they rest on a wire grating, which is raised and lowered by means of machinery, thus conveniently lowering the filled and tightly-corked bottles under the ice-water, and raising them again to the surface for handling.

These bottles are of the Cohansey pattern, and are of the capacity of one quart. The cover is secured by wire clamps, which, by compressing against an intervening rubber, form a tight joint. These bottles are delivered to the customer each morning, and at the same time the empty ones are returned to the farm, where, after a thorough cleansing, they are again filled for use.

The upper story is on a level with the ground in the rear. Under a shed is the delivery, each can of milk being weighed at the scales, and the weights charged off. The cans are then moved into the delivery room, and the milk is emptied into the tank within the refrigerator-room, thence to pass by a pipe into the centrifugal machine below, or is poured into the tank for fresh-milk delivery, as described. The empty cans after being cleansed over the steam jets in the shed, are stored in the delivery room until again put into requisition.

The cans used are of the capacity of 20, 30, and 40 quarts, and have large covers, which spring into place, and strong handles.

The next room is the wash-room. The tanks are furnished with cold water through faucets, and also with steam-pipes, through which steam is admitted to the water in the tanks to warm it. Movable draining trays, or slatted tables on casters, receive the bottles after the cleansing in the hot-water tanks. Into this room open the stairs from the lower floor; and other doors lead to the storage refrigerator, and the churning refrigerator-room.

In the storage refrigerator-room are kept the cream, the butter awaiting delivery, and the milk in the tank which supplies the centrifugal machines below.

In the churning refrigerator-room the cream is churned by power in a barrel churn, and the butter is worked and pressed into form for the market.

Passing into the centrifugal room on the lower floor, we find three centrifugal machines, over each of which is a pipe connecting with the milk tank in the refrigerator room overhead, and three tanks in the floor, which receive the skim-milk in cans, and where the cans remain until shipped. In these tanks of water a block of ice is kept floating.

On account of the novelty of this system, it seems well to devote some space to theoretical and practical considerations upon this method of dairying, and in the proper place to consider the advantages which are claimed, and such as may be admitted to belong to it. From the nature of the material in use—milk—and from the character of the forces employed, it must happen that the observations of different reporters must vary according as there is variation in the milk, in the forms of the machines in use, and the speed at which they move. This we will proceed to do before we pass to the utilising of cream for butter.

Theoretical and Practical Observations — Centrifugal Cream Raising.—The value of this process in saving more of the butter from milk than the ordinary methods of setting milk has not been systematically shown by Mr. Burnett, although a few experiments indicate a gain, which will be figured further on. In an excellent summary of European experiments by Dr. T. R. Englehardt, he offers the results of European determinations between the centrifugal raised cream, and that obtained by the ice and Holstein method. Two hundred pounds of milk were used for each experiment, and the correctness of the obtained results were verified by chemical analysis of the butter, buttermilk, and skim-milk obtained in the operation. The vessels for the ice method held 50 lbs. of milk each, and were filled to the depth of 16 inches; time employed, 34 hours. The centrifugal used was the Lefeldt machine, running 1040 revolutions per minute, except from August 8 to September 2, when its motion was irregular, and after this date was reduced to 950 revolutions per minute. At the higher speed 31 minutes, at the lower speed 36½ minutes, were occupied in the gaining of the cream.

POUNDS of MILK per ONE POUND of BUTTER.

Date.	Centrifugal.	Ice, 38 hours.	Holstein Method.
1879—May	27·6	30·0	30·4
June	26·4	28·3	28·8
July	26·8	28·0	30·5
August 1 and September 2	28·5	27·7	31·7
September 3 to	26·6	27·6	30·9
October	24·3	28·7	27·9
November	24·6	31·5	28·4
December	24·2	28·5	27·4
1880—January	25·8	27·8	28·0
February	26·4	27·4	27·8
March	27·8	28·8	29·5
April	29·3	28·4	30·1
Average	26·5	28·5	29·2

The gain of the centrifugal process over these other methods is shown by the annexed table:—

Date.	Proportional Results between—		
	Centrifugal.	Ice, 38 hours.	Holstein Method.
1879—May	100	92·3	90·6
June	100	93·2	91·2
July	100	85·7	87·9
August 1 and September 2	100	103·2	90·1
September 3 to	100	96·4	86·2
October	100	84·7	87·0
November	100	78·1	86·5
December	100	84·9	88·4
1880—January	100	72·9	96·9
February	100	96·3	94·9
March	100	96·4	94·3
April	100	96·1	94·0
Average	100	91·7	90·2

Neither these percentages nor the butter yield indicate a milk of such good quality as is used in America, for the best result here indicated is, for the year, 26·5 lbs. of milk to 1 lb. of butter, while under the system of setting in vogue in factories in America it is 23·18 lbs. of milk for 1 lb. of butter, thus;—

Years.	Number of Factories Reporting.	Average pounds of Milk to 1 pound of Butter.	Extremes.
1871	6	23·05	22·54 and 25·16
1872	4	22·88	22·3 and 24·26
1873	6	23·5	22·36 and 24·4

The difference between the centrifugal and other methods in our tables is in favour of the centrifugal 8·7 per cent. and 10·9 per cent., respectively, or about the same as Mr. Burnett has found, for his few trials have given:—

	Pounds of milk to 1 pound of butter.
For the centrifugal	16 to 20
For the deep-can setting	17 to 21

That is, on the mean of these figures, each 100 lbs. of milk in the centrifugal process yielded 5·55 lbs. of butter; in the deep-can process, 5·26 lbs. of butter—a difference of 0·29 lbs. in favour of the centrifugal, or 8·1 per cent.

In the buttermilk from 100 lbs. fresh milk, in these foreign

experiments, were found of fat: in that of the centrifugal, 0·07; in that of the ice method, 0·06 per cent. of fat, and in that of the Holstein method 0·07, thus *indicating* a churning quality in the order given. The skim-milk analysed for fat gave—

	Average.	Extremes.
		Per Cent. Fat.
For the centrifugal	0·35	0·25 to 0·44
For the ice method	0·62	0·34 to 1·54
For the Holstein method	0·68	0·40 to 1·03

Some interesting experiments made in Austria by J. A. Von Tschawel and Dr. Engling, with an improved Lefeldt machine, gave the following results to analysis:—

COMPOSITION.

80 minutes in Centrifugal.

Constituents.	Milk.	Skim-milk.
Water	88·11	91·61
Fat	4·12	0·37
Casein	2·80	2·76
Albumen	0·34	0·41
Sugar	3·85	4·11
Ash	0·78	0·72
70 minutes in Centrifugal.		
Water	88·73	91·85
Fat	3·82	0·31
Casein	2·64	2·62
Albumen	0·42	0·46
Sugar	3·66	4·05
Ash	0·73	0·71

An analysis made of the milk and skim-milk used in Mr. Burnett's centrifugal in the winter of 1879, by Lawrie and Terry, is as below, the time in the machine about fifteen or twenty minutes.

Constituents.	Milk.	Skim-milk.
Water	85·58	89·68
Fat	4·42	0·90
Casein and albumen	4·41	4·24
Sugar	4·88	4·44
Ash	0·71	0·74

Another analysis, this last by S. P. Sharples, October 22, 1880, of the milk of the preceding day, gave :—

Constituents.	Milk.	Skim-milk.
Water	87·94	90·47
Fat	2·23	0·07
Casein, &c.	4·24	4·03
Sugar	4·85	4·70
Ash	0·74	0·77

The specific gravity of the cream at about this time, as prepared for market, was determined by me as 1014. A sample taken from the machine, ran purposely for a considerably longer time, gave a specific gravity of 962; more recent results give even less, 956·4, the cream being longer under the influence of the machine.

It is of interest to note that all the heavier impurities in milk, under the influence of the centrifugal force, seek the circumference. Here collects, after a time, a slimy layer, greenish in colour, largely miscible in water, and extremely offensive. The microscope develops granules, epithelial cells, and various constituents of dust. A sample analysed by Lawrie and Terry gave :—

Water	67·38
Fat	3·25
Casein, &c.	25·49
Ash	3·88

October 21, 1880, I was on hand early in the morning, and superintended an experiment with the larger machine. The process was carried on by the man in charge in the usual course, except that the machine was run from 7.45 A.M. to 8.25 A.M. before the cream was commenced to be removed, a rather longer time than usual, or forty minutes. The last of the skim-milk was removed by 8.42 A.M., this intervening time being caused by the addition of a quantity of skim-milk after the removal of the cream by the pipe-scoop, after each successive withdrawal of cream, in order to bring the cream surface over the horizontal diaphragm, which has no obvious object or use as connected with the theory or working. The analysis of the milk, as collected in a bottle from the pipe leading into the machine from the delivery tank, was found by S. P. Sharples to be :—

Specific gravity	1,033
Water	87·94
Casein, &c.	4·24
Sugar	4·85
Fat	2·23
Ash	0·74
	100·00

This indicates a milk of rather low quality, but it applies to the milk as brought in by the farmers from stock fed probably on corn stover and frosted pasturage, and perhaps to be considered as from short-horn and Ayrshire grades, with, say, 10 per cent. of Jersey blood.

In forty minutes from starting the machine, an 8-oz. bottle of cream—taken for analysis—yielded the following result :—

Specific gravity	9,564
Water	49·45
Fat	43·14
Casein, &c.	3·31
Sugar	3·70
Ash	0·40
	100·00

It may be interesting to compare this analysis with others :—

Kinds of Cream.	Water.	Fat.	Casein, &c.	Sugar.	Ash.	Authority.
Mixed cream	59·25	35·00	2·20	3·05	0·50	Muller.
Country cream	49·00	42·00	4·20	3·80	0·60	Perry.
Jersey cream	36·40	56·80	3·80	2·80	0·20	Do.
Cream	74·46	18·18	2·69	4·08	0·59	Voelcker.
Centrifugal cream	29·54	67·63	1·17	1·42	0·12	London Farmer.

As soon as the cream was all removed, I took samples of skim-milk from the layer just below the cream, and from the outermost layer. The analyses were as below :—

Constituents.	Inner Sample.	Outer Sample.
Water	90·44	90·50
Fat	0·05	0·10
Casein, &c.	4·13	3·83
Sugar	4·60	4·80
Ash	0·78	0·77
	100·00	100·00
Specific gravity	1,035	1,035

A sample of buttermilk analysed :—

Specific gravity	1,035
Water	88·96
Fat	1·41
Casein, &c.	4·47
Sugar	4·25
Ash	0·91
	100·00

These samples were all tested for albumen. There was none found by Mr. Sharples in the ordinary form as precipitated by heat or acids from the whey, but an undetermined amount of lacto-proteins was found to exist in them all. We place, for comparison, the specific gravities as obtained :—

The milk	1,033
The cream	956
Skim-milk	1,035
Buttermilk	1,035

In order to comprehend these results it is necessary to discuss the theory of the force.

Cream Disposal.—The cream in the refrigerator-room finds two outlets for market. A portion, depending upon the demand, is taken to the bottling-room, and sealed in quart bottles, for delivery to customers as fresh cream. The balance is transferred to the churn in the adjoining refrigerator-room.

The cream after standing twenty hours is churned in a barrel churn, moved by power, at a temperature of 60°, and the process usually occupies about twenty-five minutes; about 12 gallons of cream at one time, which yields about 70 lbs. of butter. After the butter is gathered in the churn, it is washed three times with pickle, and removed to the butter-worker, where it is freed from buttermilk, and salted, 4 ounces of salt being used to 10 lbs. of butter.

The butter-worker used is the one known as the Vermont Machine Company's butter-worker. The roller compresses the butter into a thin layer, and the moisture is sopped up with a moist sponge pressed against the butter. After being sufficiently worked in the judgment of the operator, it is formed by wooden pads into a block, and removed to a table preparatory to being weighed out into half-pound parcels, and pressed into shape. Much depends upon the working; to gain high-class butter this process must not be continued too long, as the tendency is to destroy the grain and make the butter salvy; nor yet must it be shirked. The buttermilk requires to be worked out, and only the water of combination, so to call it, left behind.

Good butter wants to appear dry when cut; no water must be

seen bedewing the surface cut by the knife, and yet it is probable that the best-quality butters contain the largest quantity of water. In this respect, *other things being equal*, the quantity of water shown by analysis grades the butter examined into its respective qualities; but, unfortunately, other things are not equal, and analysis does not represent the taste and texture upon which the quality depends.

In October, 1876, a sample of Mr. Burnett's butter, made from cream raised in the ordinary way, yielded to analysis, to S. P. Sharples:—

	Per cent.
Fat	86·01
Water	11·15
Casein, &c.	1·77
Ash	1·07

This butter was high-coloured, hard, firm, full-grained, and apparently dry, notwithstanding the 11·15 per cent. of water shown in the analysis.

October 28, 1880, analysis, also by S. P. Sharples, the centrifugal cream butter gave, no salt having been added:—

	Per cent.
Fat	84·53
Water	14·27
Casein, &c.	1·11
Ash	0·09

This butter was high-coloured, firm, rather soft-grained, and apparently dry; of excellent quality, however, the principal defect being the lack of grain.

In November, 1876, Mr. Sharples analysed for me several samples of butter gathered from the dealers.

	Retail Price per Pound.	Water.	Fat.	Casein, &c.	Ash.
		Per Cent.	Per Cent.	Per Cent.	Per Cent.
No. 1	$0 90	11·15	86·01	1·77	1·07
No. 2	80	9·44	87·78	2·02	0·76
No. 3	75	9·94	85·89	2·68	1·49
No. 4	40	9·52	86·95	1·65	1·88
No. 5	25	9·88	87·14	1·90	1·08
No. 6, centrifugal, 1880	..	14·27	84·53	1·11	0·09

Nos. 1, 2, and 3, Jersey butter; No. 4, largely, if not entirely, Jersey; No. 5, sample of tub butter of rather poor quality. This No. 5 had drops of water over its cut surfaces, while the other butters appeared dry. No. 6, the centrifugal of recent make, containing more water, less fat, less casein, and less ash than any.

It is evident that if much water in butter is no disadvantage

to the quality, and is satisfactory to the consumer, that that dairyman whose butter, other things being equal, contains the most water is gaining an advantage, and an advantage of considerable importance.

The butter is pressed by a machine into blocks, and stamped with a monogram which marks the half-pound lump into two portions, so that the consumer can, by dividing, have neatly formed pats of a size proper for the table without injury to the appearance of the stamp.

Wherever extra price is obtained, much attention must be given to the attractiveness of packages, and this plan has been found not only satisfactory to the consumer, but to remunerate as well the slight extra expense which follows its use. These pats, each wrapped in a small piece of wet linen and stowed into tin boxes of slight depth, are thus sent to market.

System.—The system adopted is to make each employé responsible for certain well-defined duties. Upon entering the dairy-room, a framed placard is to be seen, thus:—

DEERFOOT FARM, SOUTHBOROUGH, MASS.

DAIRY DEPARTMENT, OCTOBER, 1880.

Basement.—Mr. M——, responsible for machines, shafting, tanks. Also entry, stairs, &c.

Milk-room.—A. O'C——, responsible for tank, windows, elevator, &c.

Upper-floor piazza.—C. R——, responsible for cans, milk pails, sinks, racks, windows, scales, brass, &c.

Refrigerators.—J. E. M——, responsible for churn, shafting, cream pails, butter utensils, &c.

J. E. M——, *Foreman.*
W. E. BURKE,
General Manager.

This placard indicates what in handling milk must never be overlooked, the necessity of absolute cleanliness, and the most scrupulous care exercised to prevent offensiveness in any form. In this respect Deerfoot Farm is indeed a model. The amount of water used is enormous. Hot steam is in constant requisition for scalding almost every surface, and rubber wraps and scrubbing cloths are in use almost continually.

The men employed are dressed in white overalls, and sacks and aprons. The tin is everywhere bright; wherever brass appears it is in full polish; the air is sweet, and no foul odours anywhere; and this is the case not only within the dairy buildings and the cow stables, but everywhere around them.

One man is employed on the machines in the centrifugal rooms; he also cares for the skim-milk. Another man cares for the bottling, which includes the washing of the bottles and other minor duties. A third man has charge of the butter

manufacture. Over all is the skilful and exact supervision of the general manager, and behind him the proprietor.

A steam-engine of 10-horse power furnishes the force required in both the dairy and the pork department, and this requires an engineer, who is also his own fireman. The large boiler furnishes steam from 80 to 90 lbs. pressure, for all wants, and the surroundings here are all in perfect neatness and even brilliancy. By means of shafting the power is carried to the centrifugal machines, the churn, and the elevator. Other shafts connect with the pork-room to move the machinery there, while still other lines of shaft move the pumps which elevate the water used, the grindstones, &c. From the boiler the steam is carried wherever it is wanted to be used in cleansing utensils or surfaces, for heating water, for trying out lard, for cooking pigs' feet, &c.

Claims.—The claims for the centrifugal process are:—

1. It will do away with the bother and expense of setting milk in pans for cream raising.
2. It will necessitate the use of less capital in the erection of dairy houses and fittings.
3. The cream can be separated from the milk as soon as withdrawn from the cow, and the cream churned immediately.
4. It opens up a new business in supplying fresh cream to consumers, who will not be slow in discovering its merits.
5. It will admit of the manufacture of sweet skim-milk cheese.
6. It offers economy in disposing of all the products of milk, fresh cream, fresh skim-milk, sweet buttermilk.
7. A more complete separation of the cream from milk than can be obtained by the ordinary process.
8. It admits of the quick and ready disposal of surplus milk left over on the hands of milk contractors, and thus is of assistance in diminishing the waste inseparable from the handling of milk, and bringing it before the consumer.
9. It purifies the milk completely by throwing out the slime and all extraneous matter.

The claims which, from present experience at Deerfoot Farm, may be reasonably allowed, are:—

1. Purity of product.
2. A larger yield of butter than by the ordinary system.
3. A fresh skim-milk, and hence in a better condition to market.
4. Diminished waste in the handling.
5. A quality of cream which is unsurpassed for table use.
6. It is proved, however, that the cream gives better butter-results after being kept some time than when churned fresh, and hence the advantage of fresh buttermilk is not realised.

7. A probable economy in the fixtures required and in the expense of handling.

It has been observed in foreign experiments that the skim-milk makes not as good-quality cheese as ordinary skim-milk. This is in part from the absence of fat in it, and in part from conditions which as yet seem obscure.

Our Conviction.—It seems to us that the use of the centrifugal machine will ultimately revolutionise the milk interest, although, as yet, its use must be deemed experimental only. In time, manufacturers will realise what the dairyman requires in a machine, and inventive genius will seek its reward in this direction. It will be seen that the conditions required for a farmer's dairy centrifugal are different from those required for the factory where much milk is handled, and where abundance of power is at hand. A machine at low cost, one that can be revolved at a sufficiently high speed, by such a power as a farm can support, will tend to make easier the care of the milk and enlarge the profits. A dairy of twenty cows would save enough yearly in extra butter produced to pay for a machine.

In our opinion, the farm machine must belong to the self-delivery class, be one in which the milk can be passed in a steady stream, and which will separate the milk into cream in one pail and skim-milk in another. It must be simple in construction and efficient in action. The time occupied, if not unreasonably long, is of little consequence as compared to the economy of construction and running, and to efficiency.

The dairy machine may be larger and more complicated, if necessary to secure greater efficiency, and may be intermittent or permanent in delivery, as may be found most desirable.

The use of centrifugal machines for cream-raising will also, in our opinion, call attention to the differences between milks, and will thus tend toward an increased attention to securing uniformity of milk by the use of milk from distinct breeds of cows. From a theoretical and experimental position it may be prophesied with considerable certainty that the best results will occur where large globuled milks are used, and where the feed is of a nutritious and succulent character.

It is also probable that the centrifugal machine may find use in the cheese factory in the manufacture of rich cheeses, and it is likely that at a less speed than for cream raising it may be used to drain the whey from curd. It can certainly find profitable use in city supply. Milk unsold can be quickly and cheaply separated into cream for the making of butter, and thus souring and other waste prevented.

Further experimentation is, however, required in order that the possibilities of profit to be acquired through the use of this

force may be demonstrated. What is its cleansing power on the milk? What the effect of working upon milk rendered more dense by the addition of sugar or salt? What is its effect on the fats, as influencing butter-making and butter-keeping? What change, if any, does it produce on the skim-milk? Can this force be used in cheese-making for the separation of the curd as coagulated? Can adulteration be detected by its aid? And so we might continue; but until experiments are carefully made, such conjecturing must belong to the region of fancy rather than to that of reality.

XXVI.—*On Wheat Mildew.* By William Carruthers, F.R.S., Consulting Botanist to the Society.

The minute fungi which live on other plants and produce blights or diseases, have received special attention in recent years, because of the serious losses which they bring with them, and because of the remarkable facts in the economy of vegetable life which their study has disclosed.

The hop, the vine, the potato, and the different cereal crops are equally liable to great injury, and sometimes to destruction, from the attacks of these parasitic plants. And none is more wide-spreading in its attack, and more serious in its action, than the mildew which attacks the wheat-crop in summer or autumn.

The desire to discover some means of preventing or alleviating the malady caused by mildew, has led to the frequent careful study of this plant. In the second volume of this Journal (pp. 11 and 220), Professor Henslow, in a paper on the diseases of wheat, gave a careful description of the mildew, and reasons for believing that rust and mildew were produced by the same fungus. He also investigated the prevalent notion that the barberry was in some way connected with the mildew, and recommended that experiments should be instituted with the view of testing the matter. He was not himself prepared to accept the opinion, though he records a case which he found it hard by any other explanation to understand. A farmer in Oxfordshire had a field which, when sown with wheat, was generally infected at one portion with mildew. This part was in the immediate neighbourhood of an old hedge, in which there were several barberry bushes. The blight did not extend farther than twenty yards from the hedge, and it was most abundant in the immediate neighbourhood of each of the somewhat widely separated bushes. The farmer had all the barberry

cut out of the hedge. He took one of the largest bushes and placed it in the middle of the field. Before reaping he found the straw, for some yards round the bush, injured by mildew, though not to the same extent as on the side of the field nigh to the hedge.

A later volume of the Journal contains an able and lucid exposition of the parasitic fungi of the British farm, which had been delivered as a popular lecture by the Rev. Edwin Sidney, and among them is included the mildew fungus.

Until the investigations of Tulasne and De Bary, nothing was added to the knowledge of the mildew, beyond what was contained in these papers.

The belief held by Henslow, that rust and mildew were produced by the same fungus, was demonstrated to be the case by Tulasne, who proved that the rust was an earlier stage in the life-history of the plant which afterwards produced the mildew.

The relation between the barberry and the mildew was established still later by De Bary, who discovered that the cluster-cup or *Æcidium* on the leaf of the barberry was a still earlier state of the mildew than the rust.

That a plant might spend some stages of its life in conditions and under a form different from its perfect state, was in harmony with obvious facts in the animal kingdom. The development of the grub living in the earth or swimming in the water, into a fly or beetle inhabiting the air, made one familiar with great changes in the life-history of an organic being. The perfect state was easily determined, because only in that state had the animal the power of producing eggs, and so providing for the continuance of its kind. But in these parasitic fungi, each stage ended in the production of spores, that is, of bodies equivalent in function to the seeds of flowering plants or the eggs of animals, and capable of developing fresh individuals.

The structure of the fungus in the different stages of its existence, as the *Æcidium* on the barberry, and the rust or mildew on the wheat, was so very different, that botanists could not entertain the notion that any organic relation existed between them, and those most intimately acquainted with these parasitic plants, were most decided in their views as to the absurdity of entertaining such a notion. Especially did it appear improbable that the plant grown from a spore should have no resemblance to the parent producing the spore, but that instead it should belong to a group which the scientific student had widely separated from the parent. Within the last ten years our first authority in England wrote: "There has been a very unjust charge brought against *Æcidium berberidis*, a beautiful species, which attacks the leaves, flowers, and young fruit of the

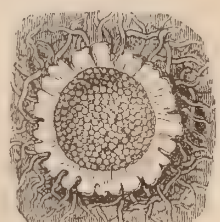
barberry, as if it were the cause of mildew in wheat. Great, however, as are the changes which fungi undergo occasionally in passing from one condition to another, there is not the slightest reason for imagining that the *Æcidium* is a transitorial state of wheat-mildew. It has its own mode of propagation, and passes through nearly the same phases of vegetation as the mildew, without affording a suspicion that it is not a perfect plant. The whole story has no doubt arisen from the *Æcidium* being common on the barberry in hedges surrounding wheat-fields; and there is reason to believe the report is true, that wheat has been especially mildewed in the neighbourhood of the *Æcidium*. The peculiar situation may, however, be equally favourable to either parasite; and it is to be observed that mildew is peculiarly prevalent in districts where the barberry is unknown except as a garden plant."

The careful investigations and experiments of De Bary, corroborated by the subsequent discovery by other botanists of similar phenomena in the life-history of other fungi than mildew of wheat, have, however, determined beyond all question that the *Æcidium* of the barberry, the rust and the mildew of wheat, are only stages in the life of the same plant, though each stage presents the phenomena we have been accustomed to consider characteristic of a perfect plant by producing innumerable spores or seeds capable of giving rise to new individuals. De Bary has indeed produced each stage of the plant from the spores produced by the previous stage.

Let us now trace the history of the fungus through its different forms of life.

The first stages in its life, after the rest of the winter, is that which it passes on the barberry. In the spring the leaves of this plant may sometimes be found with swollen yellowish spots, which in a short time burst through the skin, and form little bordered cups filled with a reddish powder. Under this form the plant is known as *Æcidium berberidis.* The genus *Æcidium* was, till recently, believed to contain a clearly limited and natural group of species, of which nearly forty were found in Britain on the leaves or stems of the barberry, gooseberry, buttercup, anemone, spurge, nettle, &c.

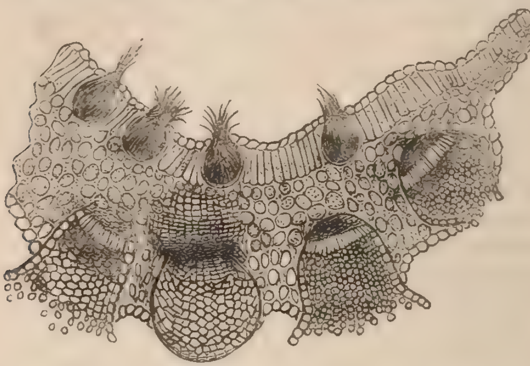
Fig. 1.—*Single Cup of a Ripe Æcidium on the Barberry Leaf.*



That on the barberry occurs chiefly on the leaves, but sometimes attacks the leaf-stalk and the fruit. It may be detected in May or June as a bright red spot on the under side of the

leaf, which, when carefully examined, is found to be a little cup full of free, round, and very minute bodies. A still more minute examination of the leaf will show that the fungus has another form of fructification on the upper surface of the leaf, where one may detect some scarcely perceptible pustules, through the central

Fig. 2.—*Section of a Portion of a Barberry Leaf attacked by the Æcidium, showing the two kinds of Fructification.*



pore of which protrude a small bunch of minute hairs. In section and under the microscope these pustules are seen to be the openings of small flask-shaped bodies filled with the delicate needle-like hairs which protrude themselves through the opening. Towards the base of the flask may be detected numerous very minute round bodies, the function of which has not yet been clearly ascertained. The larger cups opening on the lower surface of the leaf are found to be equally well defined, and to be enclosed in a distinct covering. At first appearing as little spores, they increase in size until they burst through the skin, and the apex breaks in a more or less regular manner, forming a margin to the cup, which is filled with minute round bodies of a reddish colour. These are the spores from which the next stage of the plant is developed.

Both forms of fructification grow on very delicate fungal threads, called mycelium, which penetrate the leaf in every direction, and withdraw from it the food required for the life and growth of the parasite.

The quantity of spores produced in the cups on a single barberry leaf is enormous. It is impossible to realise the myriads of fungal spores which are floating in the atmosphere during the greater part of the year, ready, whenever the fitting physical conditions are present, to germinate. No place is free from their presence. They are so minute that we see them only as

motes dancing in the sunbeam. But though so minute, they are mighty agents for good or for evil, because of their extraordinary quantity.

The spores of fungi are limited, to some extent, in their operations, by the fact that each spore can germinate only on the species of plant that is proper to it. If the seed of a flowering plant be supplied with suitable heat, moisture, and air, it will germinate in any soil, and maintain a vigorous life or otherwise, in accordance with the character of the soil. But happily the spores of these fungi must not only have the necessary physical conditions required by the seed, but they will fail in establishing themselves unless they further find these conditions associated with that particular species of plant with which their life-history is associated. Were it not so, the spores produced in a single season would be more than sufficient to clothe every inch of the surface of the earth with a dense mould.

The red spores of the barberry fungus will produce a mycelium only when they germinate on the leaf or stem of wheat, or of some other grass. And they can germinate there only when they can obtain a sufficient supply of moisture.

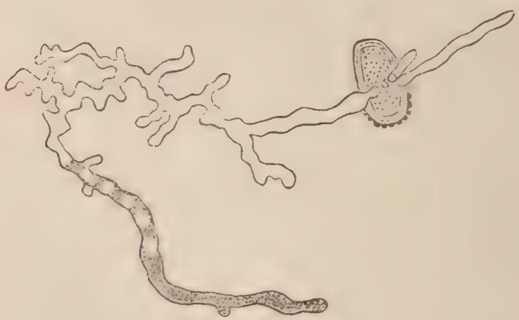
It is a very general notion that mildew and other blights are "in the air," or are produced by fogs or mists. To some extent these notions are true. The farmer has observed the atmospheric conditions favourable to the growth of the spores, and without being aware how they quickened into life the everywhere present spores, they give the physical conditions the credit of being the efficient producers of the blight. But just as dry grain remains for any length of time in the barn without germinating, so the spores of the potato-fungus rest on the potato, or those of the barberry-fungus on the wheat, without germination, if there be no free moisture accessible to them. A slight reduction of temperature, when the warm air of summer or autumn is saturated with moisture after rain, liberates some of the aqueous vapour which had formed an invisible ingredient of the atmosphere, and a mist is produced. This mist supplies the spore with the moisture it needs, and germination begins; a small tube is pushed out, and, finding its way to one of the minute openings or stomates of the leaf, it passes through into the tissues, where, finding suitable food, it rapidly grows. In

Fig. 3.—*The Spores of the Rust in Wheat.*

a week or ten days one can detect the presence of the fungus in the wheat by linear reddish swellings on the leaf and stem. When ripe, the skin bursts, and innumerable oval red spores are exposed and dispersed.

When the suitable conditions are present, these spores germinate on wheat or on other grasses, the growing tubes pass through the stomates, produce mycelium in the cellular tissues of the leaf, and in a week, more or less, a new crop of spores bursts the skin of the plant, and is scattered in the air. Several generations of this form of the fungus may be produced in the course of a few weeks. In the older patches, and from the same mycelium, another kind of fruit is produced, at first among the red spores of the rust, and then entirely by itself, when the production of the rust-spores ceases. These are the spores of

Fig. 4.—*A Germinating Spore of Rust fourteen hours after it was shed.*



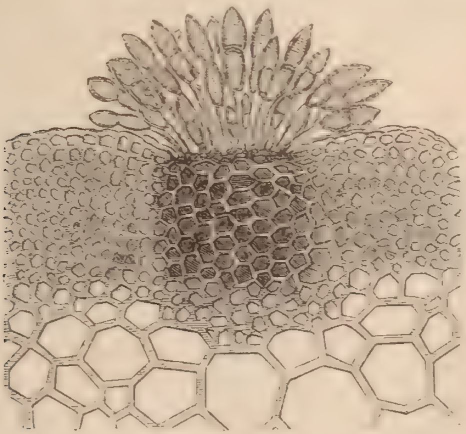
the mildew. In the drawing of the rust-spores (Fig. 3, p. 449) one of these spores may be observed. These new spores are oblong, and taper towards each end. They are composed of two cells, the division being across the middle of the spore.

As in the rust, the delicate threads or mycelium of the mildew penetrate the cellular tissue of the leaf or stem in every direction. The spores are produced under the skin. They form long narrow swellings of a brownish colour. When the swellings burst the skin, a mass of dark spores fills the opening. If the disease is very bad, the plant is so completely covered with the dark spores that it has the appearance of having been scorched.

The active life of the fungus closes with the production of the mildew-spores. These spores do not germinate and propagate the mildew in other wheat-plants. This is done only by the spores of the rust. The mildew spores remain on the leaves

and straw throughout the winter, and show no signs of life till the spring, when, under favourable conditions, they begin to germinate. Each of the two cells of which the spore is com-

Fig. 5.—*Section through part of the Straw of Wheat, showing the Ripe Spores of the Mildew.*



posed sends out a short filament, that terminates in three or four branches. The tips of these branches swell, and another kind of spore is produced, after which the filament dies. These minute and delicate spores develop a mycelium only when they germinate on the leaf of the barberry. The germinating filament does not seek admission to the leaf through a stomate, but it has the power, like the spores of the fungus which causes the potato disease, of penetrating the skin where it germinates, and passing directly into the tissues of the leaf. There it rapidly grows, and in a short time produces the two kinds of fructification which have been already described.

This remarkable narrative of the year's life of this parasitic plant was foreshadowed, as has been pointed out, by Professor Henslow in a paper printed in this Journal forty years ago.

The injury done to the wheat by the rust and mildew arises from the fungus appropriating to its own use the elaborated juices of the wheat. Fungi are plants without the green colouring matter, or chlorophyl, which exists in other plants, and they are consequently unable to separate the carbon from the carbonic acid gas of the air, that is, to manufacture plant-food from the raw materials on which plants live. They therefore depend on the already prepared food of the plants on which they are parasitic. The fungus in its rust-stage takes possession of the growing plant, and weakens it so far as it

appropriates the material which was intended to build up the growing wheat. But as the wheat at the time of the attack is very active in assimilating food, the rust rarely injures to any serious extent the crop, unless in an exceptionally wet season, when the abundance of moisture secures the germination of successive crops of spores. A few bright sunny days arrest the progress of the fungus, and vigorous plants overcome the attack without any real injury.

Fig. 6.—*Spore of the Mildew of Wheat germinating and producing Spores at the Tip of one of the Branches.*

When, however, the mildew appears at a later stage in the life of the wheat, the conditions are entirely changed. The period of active assimilation of food is past. The plant has laid up stores of food in various parts of its structure, and the processes of flowering and fruiting, which use up these stores, are proceeding. The altered starch is being conveyed from the cells, where it was temporarily located, to its final destination in the seed. The fungus arrests it in its progress, and converts it to its own use. The wheat is not able to cope with the parasite as in the earlier stage of its life when the fungus was present as rust. It cannot start again the process of assimilating food, and consequently the seed is more or less imperfectly filled, in proportion to the time at which the fungus attacks the plant, and the extent of the attack.

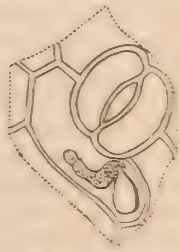
The story of the fungus suggests important considerations to the farmer. First, it is certain that the brown spores of the mildew which remain attached to the straw after harvest, are the means by which the fungus retains its vitality through the winter. Converting the straw into manure does not destroy the spores, but rather provides in the spring the conditions fitted for their germination. It may be recommending a serious destruction of property to suggest the burning of mildewed straw, but fire is the only agent that will effectually destroy the spores.

Then it should be noted that even the brown winter spore produced by the mildew will be harmless, unless the spores formed at the tips of its branches in the spring rest on the leaf

of the barberry. The farmer should not permit the barberry to have a place in his hedges, or in plantations on his farm.

Further, that while rust may in itself be injurious to the crop, it is more dangerous as the earlier stage of the mildew, and as the producer of crop after crop of spores which produce mildew. The only check to the rust is a bright sun and a warm dry atmosphere.

Fig. 7.—*The Spore produced in the Spring from the Mildew germinating on the surface of the Barberry Leaf and penetrating the Skin.*



From the history of the fungus, it is manifest that at no stage is it under our control; and though we can take steps which may prevent at different stages the unnecessary increase of the spores, we must be baffled in any attempt to prevent the appearance of the disease, whether in the rust or the mildew stage.

I have never observed any variety of wheat that has escaped mildew at a time and in a district where mildew was prevalent. Sometimes one field may suffer less than another in the same district, and at the harvest may yield a heavier and better-filled grain, but this I have found to result from the time at which the field was attacked by the disease. Some of the prepared food of the plant may have been stored in the seed before the parasitic robber interfered with its transmission. An early field may consequently suffer less. But when the atmospheric conditions have been present for the germination of the spores, I have failed to detect any difference in liability to blight, arising either from the variety of the wheat, or from the method of cultivation.

XXVII.—*A Poultry Farm in Huntingdonshire.* By S. B. L. Druce, of Lincoln's Inn, Barrister.

The following account of a poultry farm forms a part of the report on Huntingdonshire, which, as an Assistant Commissioner, I wrote for the Royal Commission on Agriculture. With the exception of the last part it is reproduced here as it was originally written.

The farmers in Huntingdonshire have endeavoured to meet the bad times * as well as they could; and among other attempts

* Huntingdonshire felt the depression in Agriculture more severely, in my judgment, than any other of the fifteen counties which comprised my district.—S. B. L. D.

that have been made, one of them has tried poultry farming on a somewhat large scale. The farmer who has tried this lives at Kimbolton, and up to a year or so ago he farmed a good-sized farm of between 500 and 600 acres; but finding things were going badly, he gave up the larger farm and retained one of about 100 acres only, and it is upon this that he is trying poultry farming. The soil of the farm is a tolerably stiff clay, and most of it is already, or will very soon be, drained. It is farmed pretty much on the four-course system, and the poultry is the chief live-stock kept upon it.

The farmer had kept poultry in some numbers for the past five or six years whilst he held his larger occupation, but he had not kept a separate and distinct account relating to them till the year 1880, and since he had given up that occupation. He stated that he was trying the system because of the very large importations of poultry and eggs into this country, and because he thought that poultry, if properly attended to and treated in a business-like way, would pay. He kept fowls only, not ducks, geese, or turkeys. He had tried various breeds of fowls, but preferred the light Bramahs to all others, because from experience he had found that breed to be the hardiest and most prolific. His stock at the time of my visit (October 1881) consisted of about 1800 head, which in the winter would be reduced by some 300 or 400, so that at that period of the year he would have about 1400 or 1500. He keeps no old stock, but sells all his birds before or when they are two years old. He is careful to have fresh blood in his stock every year, and for that purpose periodically introduces three or four male birds of some other strain than his own of the light Bramah breed. His stock has always been healthy, and absolutely free from any epidemic during the six years that he has kept it, and though he has occasionally lost a few birds, his losses from disease have been very trifling. He keeps the poultry partly in yards at the farm-homestead, and partly in the fields. There are nine yards at the homestead of different sizes, for convenience sake, and separated from each other by wire netting; and attached to or near them are houses for the fowls, such houses being parts of the farm-buildings adapted for that purpose. The fowls in the fields are divided into different lots, each lot containing about 150 birds, and having a separate fowl-house; these houses are about 16 feet long by 8 feet wide, and 6 feet high up to the eaves of the roof, and contain from 750 to 800 cubic feet each, or rather more than 5 cubic feet to a bird. They are built of wood, and are moved from one part of a field to another very easily by one horse. The field-houses, when I saw them, were on a piece of land that had been laid down to grass about two

or three years ago; and just previously they had been on some young seeds sown in a barley crop which had not long been harvested. As soon as the ground near the house has become much trodden, the house is removed to some other spot. These removals take place about every fortnight. The yards at the homestead are changed once a year, and the ground which has been used as a yard is left for a year without any fowls being put upon it, in order that it may become sweet, and freed from the taint of the birds. All the houses are scrupulously clean, and are constantly lime-washed. The birds, except the young chicken, are fed three times a day; in the morning with soft food, consisting of boiled potatoes, mangolds, carrots, or parsnips, mixed with barley-flour, which mixture is given warm in the winter; in the middle of the day they are fed with inferior corn; and at night with a full feed of sound maize—the best description of that corn only being used, and it is given to the fowls whole, and not split. No particular quantity of food is given at either meal, but notice is taken whether any of that which is given is not picked up, and if such is the case, less is given. Occasionally the fowls have green food, and in the winter, meat. The meat is boiled horseflesh or beef, and care is taken that the meat is that of a sound animal, and of an animal that has been killed, and not of one that has died a natural death. The chicken are fed as often as six times a day, with all sorts of food, and are most carefully looked after by the man in charge and his boy, who are the only labourers employed for the poultry. The manure made by the fowls is used on the farm as a top-dressing for corn, and is mixed with malt-dust or kiln-dust, which is spread over the floors of the houses, and absorbs the manure when it is dropped. In this way the houses are more effectively cleaned out, and the manure so mixed is found to be very efficacious. The poultry and eggs are for the most part sold for consumption in London, but occasionally a few of each are sold locally. The following is a statement of the receipts from and expenditure upon the poultry for the year 1880:—

RECEIPTS.	£	s.	d.	EXPENDITURE.	£	s.	d.
For Eggs and Poultry sold in London ..	433	10	10	Paid for Food	330	0	0
„ to House	16	1	0	„ „ Labour	55	0	0
„ „ Dowden	2	10	0	„ „ Eggs	10	0	0
„ „ Others	9	10	0	„ „ Rent	38	0	0
„ Manure	27	0	0	Depreciation and Renewal	18	10	0
„ Feathers	3	0	0	Interest	15	0	0
				Balance (Profit)	25	1	10
	£491	11	10		£491	11	10

The capital employed in the poultry farm was taken at 300*l.*, and was considered as being the same at the beginning and at the end of the year, and interest at 5 per cent. on that amount is allowed in the foregoing account; there was, however, in fact, rather a larger head of poultry at the end than at the beginning of the year, the actual numbers being—

On January 1st, 1880	1433
On January 1st, 1881	1482

but the difference in number was not sufficient to make any material difference in the value. Of the 300*l.* capital, 200*l.* was taken as the value of the poultry, and 100*l.* as the value of the fowl-houses and other dead-stock; but the former sum seemed to be very inadequate, and, upon consideration, the farmer added this note to the above account: "I have charged 5 per cent. interest on 300*l.*, viz. 200*l.* for poultry, and 100*l.* for houses, though I consider my fowls, being pure light Bramahs of noted strains, are worth 400*l.*" If then we take the whole capital in the concern at 400*l.* (the mean between the capital of 300*l.* on which interest is calculated in the above account, and 500*l.*, the amount at which, upon further consideration, the farmer estimated it), which would, as far as I could make out, fairly represent the actual capital invested in the concern, we find that a return of some 40*l.*, or 10 per cent., was made; the 40*l.* being divided in the account into 15*l.* for interest, and 25*l.* for profit; but if we take the capital at 400*l.*, and allow interest at 5 per cent. on that sum, we have only 20*l.*, or 5 per cent., left for profit.

This farm seems to be a fair example of what can be done by poultry farming, for there are no special or adventitious circumstances as regards soil, position, or otherwise, connected with it, but the farmer thoroughly understands the business; he is learned in poultry, and devotes much of his time to them. He is not only fond of poultry, but of other animals, as is shown by the fact that he keeps a large number of bees on the most approved modern and scientific principles, from which he endeavours to make a profit. I cannot, however, state whether his bee-keeping has been profitable, for he has only kept them in large numbers during the past year, and has not kept separate accounts for them. I need hardly add that this poultry- and bee-farmer does not depend upon his poultry and bees and his small farm alone for a livelihood. In reply to my question whether he thought that poultry-farming on a very large scale would pay, he said he thought not; but that the best and most paying way to keep poultry was for the cottagers to keep a few each for the farmers,—the cottagers' wives being paid so much per head for every chicken reared.

Before sending the foregoing description to the Society for publication in its 'Journal,' I wrote to the farmer whose poultry farm I have described to ask him for a copy of his balance-sheet for the year 1881, in order that the description might be brought down to as late a date as possible. In reply to my letter the farmer wrote as follows:—

"I have been trying to get out a balance-sheet of my poultry farm for the year 1881, but find I cannot get at all the details, owing to their being mixed with the other business transactions, but I am satisfied, were I able to do so, they would not be found more satisfactory than those I gave you, in a financial point of view; in fact, my impression is such that I intend much reducing my stock and breeding for fancy sale only, feeling assured that breeding for the market cannot be made to pay on a large scale. I much regret being unable to comply with your request."

This letter would appear to show that the longer experiment had convinced the farmer of the correctness of the opinion he expressed to me, namely, that poultry farming on a very large scale would not pay.

XXVIII.—Recommendations of the Royal Commission on Agriculture.

Prefatory Note.

The Royal Commission on Agriculture has concluded the most laborious and comprehensive Agricultural inquiry ever instituted. The abstract conclusions arrived at by the Commission are appended. Twenty Commissioners and ten Assistant-Commissioners, as may be well expected, have elicited a mass of valuable information—matters of fact and matters of opinion—recorded in several huge volumes, which to the general reader are costly and inaccessible. There is a growing feeling that, in a cheap and popular form, the more important and interesting portions of the Report of the Commission should be reprinted by authority; and perhaps the Council of the Royal Agricultural Society might advantageously be moved to promote this demand. But it is a question for future consideration whether or not we should really benefit the agricultural student, or agriculture in general, by an attempt to crush the mass of valuable matter into a form that would harmonise with the character and objects of this Journal. There can be no doubt, however, that we are right in doing all that time and space now

permits—that is to place on record, as a matter of history, the conclusions arrived at by the Royal Commission; and especially to commend to the attention of all interested in agriculture the mass of evidence collected and garnered—indeed, a storehouse of invaluable facts and opinion: the full-length Portrait from the Life of the distressed Giant of British Agriculture, together with his home and foreign relations. It would be invidious and unnecessary to mention names: it suffices to refer to the official list of witnesses. From a professional point of view, the vividly-written itineraries, at home and beyond the seas, of the Assistant-Commissioners—or some of them at least—are simply fascinating. Without any doubt or question the historian of the future will regard the results of the labours of the Royal Commission as the closure of the gates of an epoch in agricultural history, from whence the historical imagination will conjure in fresh and energetic departure the never-ending precession of agricultural phantasmagoria.

(Signed) CATHCART,
Chairman of the 'Journal' Committee.

In obedience to Your Majesty's command, we* now desire to report the conclusions at which we have arrived upon the effect of the evidence which has been submitted to us as to—

1. The depressed condition of the agricultural interest, and the causes to which it is owing;
2. Whether those causes are of a permanent character, and how far they have been created or can be remedied by legislation.

Whatever difference of opinion may exist as to the causes of agricultural depression, or as to remedies which may be suggested for it, it will be observed that there prevails complete uniformity of conviction as to the great extent and intensity of the distress which has fallen upon the agricultural community. Owners and occupiers have alike suffered from it. No description of estate or tenure has been exempted. The owner in fee and the life-tenant, the occupier, whether of large or of small holding, whether under lease, or custom, or agreement, or the provisions of the Agricultural Holdings Act—all without dis-

* The following are the signatures attached to the Report:—Richmond and Gordon, Buccleuch, Vernon, James Stansfeld, W. H. Stephenson, R. Nigel, F. Kingscote, Henry Chaplin, John Clay, Jos. Cowen, Mitchell Henry, Charles Howard, J. L. Naper, Robert Paterson, Bonamy Price, C. T. Ritchie, B. B. Hunter Rodwell, William Stratton, Jacob Wilson. (Two Commissioners had resigned before the Report came under discussion.)

tinction have been involved in a general calamity. It is important that this should be clearly understood, so that undue stress may not be laid upon suggestions for legislative changes, which, whether expedient or not, have no direct or immediate connection with the distress of the present time.

The two most prominent causes which are assigned for that distress are bad seasons and foreign competition, aggravated by the increased cost of production and the heavy losses of live-stock.

The extent to which agriculture has been injuriously affected by an uprecedented succession of bad seasons, is very clearly shown by the abundant evidence to which we have referred in a preceding part of this Report.

Bad Seasons.

Although farmers must always take their chances of the seasons, and accept the consequences as they come, yet in some districts and to some extent the worst effects of heavy rainfall may be mitigated by the prevention of floods, and an extended system of arterial drainage, which would be a national benefit.

Foreign Competition.*

Next to a succession of unfavourable seasons, the effect of foreign competition is assigned by the majority of witnesses as a main cause of the embarrassments of the agricultural community.

In considering the representations which have been made to us as to the effect of foreign competition upon the agricultural interest of this country, it is but just to recall the fact that the pressure of that competition is now found to be greatly in excess of the anticipations of the supporters, and of the apprehensions of the opponents of the Repeal of the Corn Laws.

Whereas formerly the farmer was to some extent compensated by a higher price for a smaller yield, he has had in recent years to compete with an unusually large supply at greatly reduced prices. Evidence to this effect has been already referred to under the head of "Foreign Competition."

On the other hand, he has had the advantage of an extended supply of feeding-stuffs—such as Indian corn, linseed and cotton-cakes, and of artificial manures imported from abroad.

Disastrous as the combined effect of bad seasons and foreign competition has been, the witnesses who speak in the interest of agriculture fully recognise the advantage to the community that

* Mr. Chaplin adds a supplementary Memorandum on this subject.

food should be cheap. They contend, however, that the low price of agricultural produce, beneficial as it is to the general community, lessens the ability of the land to bear the proportion of taxation which has heretofore been imposed upon it.

LOCAL TAXATION.*

The history of the various imposts that are now levied for local purposes is very fully given in the evidence to which we have already referred. The first and the most important of these is the rate for the relief of the poor.

This rate, the heaviest local impost to which real property is subjected, has been taken as the foundation upon which the whole system of local rating has been built up. Although, to adopt the words of a resolution of the Committee of the House of Lords (1850) upon Parochial Assessments, "The relief of the poor is a national object, to which every description of property ought justly to be called upon to contribute, and the Act 43 Eliz., c. 2, *contemplates such contribution according to the ability of every inhabitant;*" and although the decisions of courts of law established the liability of personal property to rating for the relief of the poor, yet, since the most recent decision in that sense, it has continued to be exempted from such rating by the periodical Exemption Act.

The practical effect of this is, that personal property is exempted not only from rates for the relief of the poor, but from others, as the cost of highways, police, and education.

This exemption is grounded, not upon justice or equity, but simply upon public convenience.

It is, no doubt, most important that expenditure for purposes which are exclusively local should be defrayed out of local resources.

Looking, however, to the difficulty of localising a rate upon all personal property, it would seem that the equity of the case can only be met by assigning certain local taxes to the local authorities for local purposes, or by defraying some portion of local expenditure out of the Consolidated Fund.

The justice of this view has been recognised from time to time by Parliamentary subventions in aid of local expenditure.

We are of opinion—

1st. That the cost of the maintenance of the indoor poor, instead of being paid, as at present, by a Union rate upon real property alone, should in future be defrayed either out of the

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* In separate Memoranda Mr. Stansfeld, Mr. Chaplin, and Mr. Paterson express divergent views on this subject.

Consolidated Fund, or by a rate or taxes equitably adjusted according to means and substance; in other words, upon the personal as well as the real property of counties or of areas wider than existing unions: "indoor poor" being deemed to include all lunatics, to whom the present subvention extends, and all children in district schools or boarded out under any order of the Local Government Board.

2nd. That a certain proportion of the local taxes should be assigned to the local authority in aid of local expenditure.

To the transfer of the maintenance of the poor from local rates to imperial taxation, two objections, each of great weight, are usually urged.

It is said that such a change in the incidence of the rate would increase centralisation, weakening local interest in local administration; and that it would also lead to great extravagance.

In respect to the transfer of the cost of outdoor relief from local rating to general taxation, these objections are, no doubt, well founded. They do not, however, apply to the transfer of the cost of indoor relief. There is no reason to apprehend that the central authority would have occasion to exercise more control than they do at present, or that guardians would take less interest in the management of workhouses.

Upon the other hand, it is urged that the change which we suggest would offer the strongest inducement to guardians to substitute indoor for outdoor relief, and thus effect, together with a great reduction of expenditure, a vast improvement in the administration of the Poor Law.

Rates.

Whatever change may be made in the incidence of local taxation, we are of opinion that, without disturbing existing contracts of tenancy, all rates should in future be borne equally by owners and occupiers.

Agricultural Labour.

The difficulties of farmers during the last few years have been greatly aggravated by the condition of agricultural labour.

Owing to a variety of causes, labour has been more costly and less efficient, so that the average labour-bill of an arable farm is at least 25 per cent. higher at the present time than it was some twenty years ago. This condition of things is undoubtedly attended with serious embarrassment to the agricultural interest.

So far as the high price of agricultural labour results from the competition of other industries, it must be accepted, just as

the low price of agricultural produce must be accepted as the effect of foreign importation.

While the difficulties of the farmers have been thus increased, higher wages and more general employment have proportionately improved the condition of the labourer. It is most satisfactory to be assured that the labouring class has been scarcely, if at all, affected by the distress which has fallen so heavily upon owners as well as occupiers. Provisions have been cheap and employment abundant, while wages in a few districts only have been slightly reduced.

In connection, however, with the unsatisfactory supply of labour, our attention has been directed to the insufficiency of house accommodation, and to the present system of education as it affects that class.

Although it is generally admitted that within the last twenty years very great progress has been made, especially upon large estates, in providing better cottages for agricultural labourers, yet, in many districts, the accommodation is still very defective. To a considerable extent the interest of owners in attracting labour, and retaining it upon the land, would no doubt operate as a sufficient inducement to provide cottages with gardens or allotments, at reasonable rents, for farm-labourers. It is due to the owners of land to state that, irrespective of considerations of interest, many of them have expended, and continue to expend, large sums of money to supply good and sufficient cottage accommodation.

A large proportion of cottages are, however, in the hands of small owners, who have neither the means nor the will to expend money on their improvement. The sanitary authorities throughout the country have certain powers to deal with cases of defective accommodation; and if these powers are exercised with judgment and impartiality, we may reasonably look forward to such improvement in the condition of labourers as would render them less inclined to abandon the field for the town.

Education.

There is a very general complaint amongst farmers that the present system of education operates prejudicially to the interests of agriculture. Boys, it is said, are kept at school at an age at which they might be usefully employed upon the farm, and be thus acquiring habits and tastes which would fit them for farm service. As it is, the standard of education is so fixed that not only are the first years of industrial training lost before a boy can attain it, but when he does attain it, he acquires with it a desire for what he regards as more suitable occupation; so that

the class which was formerly trained into farm service is now gradually absorbed into other industries. Farmers very naturally complain of this, as in districts in which there are School Boards they have to pay for education which not only deprives them, for the present, of the labour of boys, and obliges them to pay men's wages for boys' work, but tends to drain from the land the sources of future labour.

Agricultural Education.

We have received a good deal of evidence upon the subject of agricultural education in Great Britain and foreign countries, and the desirableness of encouraging scientific together with practical instruction has been urged by several witnesses.

We concur in these opinions, and, whilst we are not prepared to suggest the manner in which this instruction should be supplied, we are of opinion that the subject is well worthy of consideration.

Compared with some foreign countries, the facilities for obtaining technical education in Great Britain are very limited, although several county schools have been established for the education of the sons of farmers. The advantages of such an institution as Cirencester College are practically limited to those who, intending to adopt the career of estate agents, to farm, or to emigrate, are able to afford an expense beyond the reach of the ordinary farmer. Some impulse has been given to scientific agricultural education by the scholarships and bursaries founded by the Royal Agricultural Society of England, and the Highland and Agricultural Society of Scotland. In addition to these, the Science and Art department hold out considerable inducements by the conditions under which they offer half the cost of county scholarships.

Rent.*

It has been suggested in the course of this inquiry that for many years previous to 1875 rents had been unduly raised. The weight of evidence, however, satisfies us that such a practice was exceptional, especially on large estates, and might be attributed in a great measure to imprudent competition on the part of tenants. It would also seem that this competition was to a considerable degree encouraged by the employment of capital in the shape of advances made by country bankers on personal security, as well as by cattle-dealers, salesmen, and others. The sudden withdrawal of such accommodation, and the calling in

* Mr. Clay records his dissent from this and other sections of the Report in a separate Memorandum.

of loans so made, have, in our opinion, greatly contributed to the late difficulties of the tenant farmers.

Upon the important question of the effect of rent upon agricultural depression, several witnesses have communicated their views.

While we strongly object to any legislative interference with arrangements on the question of rent between landlord and tenant, we are of opinion that it will be for the interest of both parties that rents should be so fixed by voluntary agreement as to enable farmers to meet the difficulties of their position.

Contagious Diseases (Animals) Act.

The evidence to which we have already referred proves that the effect of the Contagious Diseases (Animals) Act has been most beneficial. Wherever the local authorities have carried out its provisions with strictness, it has been successful in checking the spread of disease. The general effect is shown by the diminished number of outbreaks and of animals attacked with foot-and-mouth disease during the last eighteen months, compared with former periods when the disease prevailed.

Pleuro-pneumonia is steadily and rapidly declining throughout the country.

These diseases, which are both of foreign origin, are brought into the foreign animal wharves from time to time. Although every precaution is taken, there can be no doubt that foot-and-mouth disease has been introduced into this country from abroad by these means. This has led to the demand for the exclusion of live-stock from infected countries, which has been urged by so many of the witnesses to whose evidence upon the subject we have already referred.

The evidence as to the discouragement which was given to the breeding of cattle and sheep in Great Britain, and the diminution in the supply of meat which arose from extensive disease in the country, appears to us to be conclusive.

Looking to the great importance of the home supply of meat as compared with the supply of live animals from abroad, and to the facility with which dead meat can be imported in the place of animals that are alive, we recommend that the landing of foreign live animals should not be permitted in future from any countries as to which the Privy Council are not satisfied that they are perfectly free from contagious disease.

In the course of this inquiry four other objects have been more especially brought under our notice, and various suggestions with reference to them have been submitted to us:—

Defects in the Land Laws;
Want of security and of compensation for tenants' improvements;
The operation of the laws of distress and hypothec; and
Restrictive covenants;

have all been referred to either as causes of agricultural depression or as tending to aggravate it.

Land Laws.*

We have already called attention to the fact that owners in fee, farming their own land, and having sufficient command of capital, have suffered not less than life tenants, or occupiers of holdings under ordinary covenants. If, therefore, we refer to certain proposed changes, we would not be understood to imply that any different condition of land tenure or of occupation would have materially mitigated the severity of the recent depression or would prevent its recurrence.

The "Settled Land Bill," presented by Earl Cairns to the House of Lords, and sanctioned by that branch of the Legislature, appears to us to be a bold, comprehensive, and most valuable measure. The ample powers which it confers upon life tenants will, if it becomes law, obviate many of the objections that have been urged against the existing system of English Land Laws.

That measure not only confers upon the tenant for life large powers of sale, exchange, and partition, as well as of leasing, but also provides for the due application of all purchase and other capital money.

Suggestions have been offered to us by many witnesses on other matters connected with the Land Laws, which are not comprised within the range of the Settled Land Bill. They seem to us to lie beyond the scope of the Commission.

Changes have indeed been suggested with a view to encourage the establishment of a peasant proprietary.

While we deem it highly expedient to facilitate and cheapen the transfer of land, we are of opinion that no special facilities should be given to stimulate the artificial growth of a system which appears to be ill adapted to the habits of the people or to the condition of agriculture in this country.

Cultivation of Land.

Among the suggestions that have been made for the amelioration of the prospects of the tenant farmer, the extension of the

* Mr. Clay dissents from this section of the Report.

growth of market-garden crops on a portion of the farm, and as a part of one or more of the courses in the usual rotation, deserves notice. The extent to which this suggestion is applicable varies necessarily in different country districts; but it seems probable that on some farms hard fruit and the less tender kind of vegetables might be grown to advantage, if sufficient capital were applied to the fertilisation and cultivation of the land, and an adequate amount of attention were given to the management of the crops. But the success of husbandry of this description must mainly depend upon suitability of soil and climate, as well as upon facility of railway carriage and proximity to large centres of population. Where these conditions are wanting, small farming, the *petite culture* of continental countries, has but slight chance of success.

Dairy Farming.

There appears to be a general agreement that, although agricultural depression has been less intense in dairy than in arable districts, the yield of milk was much diminished, and the quality deteriorated, owing to the inferiority of grass, due to the continuance of wet weather during the past few years.

The price of ordinary cheese has been seriously lowered by unusually large imports from abroad.

Sufficient attention does not appear to have been hitherto devoted to first-class dairy products, and thus many dairy farmers have suffered considerably.

The production and sale of milk are largely on the increase; it is now sent by railway in considerable quantities to London and other populous centres, and this branch of farming is assuming much larger proportions. The growing demand for milk has apparently had great influence in directing the attention of landowners and farmers to the importance of dairy farming as possibly a profitable branch of husbandry, and to the desirableness of laying down land to grass.

Adulteration.*

Of the difficulties with which farmers have to contend in the pursuit of their business, not the least formidable is the adulteration or falsification of such articles as artificial manures, feeding stuffs, and seeds; whilst farm produce has to compete with imitations, such as artificial butter, spurious cheese, and materials other than malt and hops for brewing beer. The Royal Agri-

* Mr. Stansfeld does not entirely agree with this section of the Report.

cultural Society of England, the Highland and Agricultural Society of Scotland, and other local societies, have done much to protect their members from such practices, but we think that the same protection should be given to farmers by including in the duties of the county analysts that of analysing such of the articles referred to as are not now the subject of analysis by them.

We also recommend that steps should be taken to ensure that all agricultural products, whether manufactured at home or abroad, for consumption by the public or for use by the farmer in his business, should be sold under such designations as will accurately indicate their true composition.

Compensation for Unexhausted Improvements.*

We are of opinion that, notwithstanding the beneficial effects of the Agricultural Holdings Act, there are many parts of Great Britain in which no sufficient compensation for his unexhausted improvements is secured to the tenant. In many cases landlords have not offered, and tenants have omitted to ask for, the fair compensation which we believe it is the interest of both that the tenant should enjoy, and to which we think he is entitled.

In some counties and districts this compensation is given by established customs, in others such customs are insufficient, or do not exist.

Upon the most careful consideration of the evidence before us, we have arrived at the conclusion that further legislative provision should be made for securing to tenants the compensation to which they are equitably entitled in respect of their outlay, and we recommend that the principles of the Agricultural Holdings Act relating to compensation should be made compulsory in all cases where such compensation is not otherwise provided for.

It would, however, in our opinion be advisable so far to amend the provisions of the Act as to make the compensation depend upon the additional value given to the holding. And we wish it to be understood that no compensation should be required to be paid by the landlord or incoming tenant except for outlays which are valuable to him in the future cultivation of the farm.

It having been represented to us that in Scotland difficulties arise connected with arbitrations between landlord and tenant on a change of tenancy, and between outgoing and incoming

* Lord Vernon records his dissent from this section of the Report in a separate Memorandum. Mr. Clay does the same.

tenants, and in view of these arbitrations taking a wider scope, should the suggestion we make become the law of the land, entitling tenants to be paid compensation for their unexhausted capital left in the holding, or for permanent improvements made by them, we think it would be advisable, while leaving parties interested free to make choice of any of the modes by which arbiters are chosen and appointed at the present time, to have in each county a certain number of thoroughly qualified men named by the Sheriff Principal, one or other of whom shall be appointed by the sheriff or his substitute to act as oversman in the case of the arbiters appointed by the parties failing to agree upon the selection of an oversman, or as sole arbiter, should there be any failure in the nomination of arbiter by the parties. All fees, expenses, &c., connected with such arbitrations to be levied on the parties interested, but to be in such proportion to each as the arbiter may determine, subject to taxation by the auditor of the Sheriff's Court.

Restrictive Covenants.

Many of the witnesses have represented to us that stringent covenants as to cropping and the sale of produce unduly hamper the farmer in the pursuit of his business, and do not in effect tend to increase the fertility of the soil.

We believe that the more restrictive of these covenants will be found in the older forms of leases and agreements, which were prepared at a period when all the conditions of agriculture were different from those now prevalent on well-managed estates.

Whilst we are not prepared to recommend the compulsory abolition of all such restrictions, we consider that the increased intelligence which has been manifested by those engaged in agriculture, and the general improvement in the system of cultivation which is now in progress would in many cases justify their removal.

Law of Distress.*

Although the total abolition of the law of distress has been suggested in the course of this inquiry, we cannot recommend so extreme a measure. Such a change would in our opinion operate to the prejudice of farmers, especially of the smaller class of holders.

We would, however, propose to limit the power of distraint

* Mr. Stansfeld, Mr. Clay, Mr. Charles Howard, and Mr. Paterson express their opinion in favour of the total abolition of the law of distress in separate Memoranda.

to two years, and to exempt hired machinery and agisted cattle from the operation of the law, a change which has been urged by many witnesses.

We consider that the Act passed in 1880, entitled 'An Act to abolish the Landlords' Right of Hypothec for Rent in Scotland,' requires some amendment.

Tithe Rentcharge.

It will have been seen from a preceding part of this Report that complaints have been very generally made of the mode in which the tithe averages are taken.

To meet these complaints we recommend that the rentcharge should be a fixed sum, that it should be paid by the landlord, and that every facility should be given for its redemption.

Objections have been raised against extraordinary tithes, but they appear to rest, not on principle, but on the peculiar mode of the collection of such tithes. The principle of all tithes, both of ordinary and of extraordinary alike, is that a certain portion of the produce of the land belongs of right to a special owner. But extraordinary tithes have a peculiarity of their own. The crops on which they are collected are not grown continuously; they may cease for a while, and then be cultivated again. Payment of the extraordinary tithe naturally follows the same process; it is paid when the hops are grown; it is not demanded when their growth is suspended. There is nothing in this fact which specially attacks the right to extraordinary tithe. That right remains identical with that to ordinary tithe.

Railway Rates.

In a preceding part of this Report we have directed attention to the complaints of producers, not only of the inequality of railway rates as affecting home producers, but of the still more serious disadvantage arising from preferential rates for foreign commodities.

The present law clearly contemplates that similar treatment should be accorded to similar goods carried under similar conditions, but the evidence before us shows that in many cases such equality does not exist; and we would recommend that the law should be so amended as to provide a cheap and speedy means of securing the equality contemplated by law.

We are not, however, prepared to recommend that railway companies should be debarred by legislative enactment from offering special terms for through traffic from abroad.

Minister of Agriculture.

With reference to the appointment of a Minister of Agriculture, we believe that a system corresponding to that which prevails in foreign countries would be attended with advantage, and we recommend that the administration of all matters connected with agriculture should be vested in one public department.

In submitting to Your Majesty the preceding recommendations we desire, in conclusion, to observe that—

Of the immediate causes of agricultural depression it cannot be said that any one of them is necessarily of a "permanent character." Bad and good seasons appear to come in cycles, and with them alternations of agricultural prosperity or depression.

This, the main cause of depression, no legislation can control.

How far foreign competition may affect the home producer in the future it is impossible to calculate with any degree of certainty. That its effect will continue to be felt may be assumed as certain.

It is to be hoped that the proposals which we have made will, if adopted, eventually place all classes connected with land in a better position to meet those difficulties to which they are necessarily exposed, and which are sure to be, as they always have been, of periodical recurrence.

We have already indicated various matters upon which legislative interference can benefit directly the agricultural classes of this country. But no interference between classes, between owners and occupiers, or between employers and labourers, can render any one of them independent of the other. We cannot recall a period in our history in which the relations of these classes have been more severely tried than during the existing depression. Owners have, as a rule, borne their share of a common calamity, and they, as well as occupiers, have done much to avert the distress from the class who are least able to bear it. It is satisfactory to know that, as we have already observed, upon the labourer it has fallen more lightly than upon either owner or occupier. The best hope for the prosperity of agriculture lies in the mutual confidence and friendly relations of the three classes directly engaged in it, and in the common conviction that their interests are inseparable.

In concluding this Report we may be allowed to record our opinion that the condition of British agriculture has never been the subject of a more comprehensive and laborious inquiry than that in which we have been engaged. The mass of evidence

which we have now the honour to submit for Your Majesty's consideration, collected, we believe, with the greatest care and impartiality, presents an exhaustive record of the extent and immediate effects of the agricultural depression, of the causes to which that depression may be attributed, and of the various suggestions submitted to us from opposite points of view for ameliorating the condition of the agricultural classes.

For the valuable information which has been thus collected we have to express our acknowledgments to the witnesses who have come before us, and also our sense of the aid which has been rendered by the reports and evidence of our Assistant Commissioners:

All which we humbly submit to Your Majesty.

XXIX.—*Dairy-Farming in the Netherlands.** By H. M. Jenkins, F.G.S., Secretary of the Society, and Editor of the 'Journal.'

The kingdom of the Netherlands is essentially a dairy country, from north to south and east to west. If the celebrated Dutch cows were not extraordinary milkers they would soon be supplanted by other breeds, as they are by no means quick feeders, even on the rich pastures of the provinces of North and South Holland.

South Holland is noted for its luscious Delft butter and its Gouda Cheese. North Holland is equally proud of the renowned Edam cheese and the somewhat strong Kampen butter. Friesland also, at one time, was celebrated for its butter, and is at the present day making vigorous efforts to re-establish its ancient reputation. These several districts are all favoured, partly by the endowment of nature, but chiefly by the fostering care of man, with magnificent grass-land, which ought to be capable of imparting to the milk of cows fed upon it the properties which are generally regarded as essential to the production of the finest qualities of butter and cheese. As will be seen, however, the processes of butter-making in some districts leave a great deal to be desired.

Delft Butter.—In the Delft district of South Holland we find the nearest approach to a rational system, considering the primitive nature of the dairy vessels in use. The cows are milked morning and evening, and the milk is at once placed in

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* Extracted from the 'Report on the Agriculture of the Netherlands to the Royal Commission on Agriculture.'

large copper vessels which are immersed in a bath of cold water, fed by a pump from a well. The water is really cold, and the milk remains in this cooling bath from $1\frac{1}{2}$ to $2\frac{1}{2}$ hours. It is then transferred to shallow earthenware pans in an underground cellar, constructed to keep it as cool as possible. Cream is first taken after the milk has stood for 12 hours, and again two or three times at further intervals of 12 hours. The cream of the successive skimmings is mixed together, and churned in a piston churn, which is about half filled or a little more. It takes about 1 hour to $1\frac{1}{4}$ hour to bring the butter, because the dasher is generally not large enough for the churn. Churning on the larger farms is done by horse-power, but throughout the Netherlands, on small farms, or where only a small quantity of butter is made, churning is done by a dog walking inside a large wheel or upon an inclined endless band—in either case a kind of treadmill arrangement.

The butter having come, it is collected, well washed, and left to drain in a large tub until the evening, when it is kneaded by the hand, salted, and placed for a certain time in "pickle." Each lump of butter is always carefully marked with a cross, and in some cases the devotional symbols have evidently been carved out with considerable labour. The next day the butter is packed in kegs, and it is either sent to market once a week, or is bought direct by the butter merchants. The price obtained by most farmers at the beginning of June in 1880 appeared to be about 1*s.* 6*d.* per English lb., but it must be remembered that this Delft butter is exceptionally rich and luscious. One farmer whom I visited, however, was very proud of an invention of his own. He mixed with the cream one-fourth of its bulk of new milk, and added a litre of sour buttermilk. This, he said, increased the quantity of butter and made it come sooner; but although he owned that he did not get more than 1*s.* 4*d.* per lb. for his product, I could not make him understand that the reason was that he produced a mixture of butter and curd.

The Swartz system of cooling milk is being gradually introduced into the district, and as it simply means a continuation throughout of the process of cooling, which is now adopted as the first stage in the setting of the cream, the change will be easily effected. Some farmers also put some cold water into the earthenware pans before the milk is turned into them.

The skim-milk is nearly always sold to the Hague or Rotterdam, in casks containing 80 litres (about 18 gallons), at about 2*s.* 6*d.* per cask, the consignees paying the cost of carriage. In other cases it is made into skim-cheese in the same manner as the so-called "Derbyshire" cheese in the Gouda district which

will be presently described. In June this cheese was being sold wholesale at about 30*s.* per cwt.

There is little or no arable land on the farms, which are chiefly occupied by their owners. When let to tenants the rent ranges from 3 guineas to 4*l.* per acre for the rich pasture-land of which they consist. As a rule, about one-third of the grass is manured annually and mown, but some farmers have land which they prefer to mow continually, and other pieces which they like to graze always. Cast cows are always fattened on the farm, either on grass in the summer, or on distillery refuse at any time of the year, but chiefly in the winter. The number of milch-cows kept by a farmer, who buys little or no distillery refuse or other artificial food—except such adjuncts to the hay for winter feeding as linseed-meal, linseed-cake, &c.—is one head to two imperial acres, but all the calves are sold when they are a few days old. Those farmers, however, who buy large quantities of distillery wash can multiply their feeding operations very much. One of the most "intensive" men I visited owned 22½ acres of land, and rented 10 acres more. He had 30 milking-cows in the fields and 10 feeding-beasts in the stalls. He stated that he fed every year about 30 beasts, besides his own cast cows, and spent about 670*l.* per annum in distillery refuse, beans, and linseed-meal—the last two materials being exclusively for cows in winter. This is one of the districts where distillery refuse (*spoolen*) is chiefly given to milking-cows on the grass.

On an average the farms in this district range from 50 to 75 acres in extent, rarely exceeding and not often falling below those limits. Day labourers are seldom met with, but yearly labourers who sleep and feed in the farmhouse, and who receive from 8 to 12 guineas per annum as wages, are the rule. Most of the work, however, is done by the farmer and his family. In the course of a long day's inspection of farms in this district, I called at one just at the dinner-hour, and being invited to enter, notwithstanding the awkwardness of the time, I carefully observed what went on. I counted nine pairs of sabots outside the door of the living-room (the sabots are always left outside the door of the room or the house, as the case may be). These belonged to the farmer, his wife, five children (three being grown-up sons), a servant girl, and a cowman. Deducting one little girl, who was too young to do any work, this was the staff of the farm. They all sat round a table, each person having a plate with a portion of pork on it. The meat soon disappeared, and the company then addressed themselves to an enormous dish in the centre of the table, which was piled up with potatoes, and was crowned by a basin containing some kind of sauce,

probably buttermilk. Each person, without distinction, spitted a potato with his or her fork at will, then dipped the potato into the sauce, and conveyed it into the mouth open to receive it. The plates had performed their function and were disregarded for the remainder of the meal. The dish of potatoes, however, had to be replenished before the diners were satisfied. A third course consisted of milk-porridge, made, as I was afterwards informed, with buckwheat meal. In this case the whole company ate in common out of the same large basin or bowl, using their spoons or ladles when and as often as they thought fit. I was afterwards informed in several districts that this is the general mode of feeding in small farmhouses. This farmer owns his farm, which consists of 60 imperial acres of some of the best land in the district, and worth at least 4*l.* per acre to rent, according to the prevailing standard. He keeps 40 milch-cows, sells the calves very young, makes Delft butter, and sells the skim-milk. His wife is the dairy-woman; he and his sons do most of the work of the farm, and although they live as I have indicated, and their house was not particularly neat, yet everything connected with the cowhouse and the dairy was as bright and as clean as possible. In his coachhouse were a "tilbury" and a "tentwagen," both looking like new; and no doubt on Sundays and fête-days he and his family come out in fine attire.

Kampen Butter.—South-west of the extensive and dreary tract of heath and forest land which occupies nearly the whole of the province of Drenthe and the greater portion of the neighbouring provinces, except where the peat has been excavated and the land brought into cultivation, lies the celebrated butter district of Kampen. From Zwolle to Kampen and on to the sea-coast is a real oasis in a desert. Here one sees farms of from 50 to 100 acres in extent, on which, as a rule, from 20 to 30 milch-cows are kept, and the milk is almost without exception used for the purpose of making strong-tasting butter, for the manufacturers of butterine, or artificial butter. The rent-value of the land varies from 66*s.* to 80*s.* or more per acre, and of course nearly the whole of it is in grass. In winter the cows get hay and between 6 lbs. and 7 lbs. of linseed-cake per day. In summer they are turned out on the pastures and receive no artificial food. About half the land is manured in spring every year, and mown for hay in due season. Straw is very scarce, therefore the horse-litter is forked over and the best of it is used a second time for the cows. In the year 1880 there were a smaller number of cows on the farms than is generally the case, although most of the farmers are proprietors, except in Kampereiland, which is the property of the town of Kampen, and is let to tenants under somewhat curious conditions.

The method of making butter in this district may be described in a few words. In summer, when it is chiefly sold for immediate consumption, the cream is churned in the ordinary manner, but without such preliminary precautions as to its treatment as are observed in the Delft district. At other periods of the year the butter is made specially for the manufacturers of artificial butter, and then the milk and cream are churned together, the skimming process being dispensed with, after the milk has stood long enough to get sour. Churning takes place two or three times a week, according to the season and the number of cows kept; but the one object kept in view is to produce an article of sufficient strength of grain and flavour to meet the requirements of the makers of artificial butter. Near Deventer, which district is a continuation of that of Kampen through Zwolle, the process is even more accentuated, for before the butter comes, a quantity of unwashed butter, made at the previous churning, is put into the churn, the excuse being that it facilitates the process of washing the butter, and cleansing it from the buttermilk.

Friesland Butter.—In this district butter is made, as a rule, in the same manner as in the Delft district, but the cream is often churned too sour, and not skimmed with sufficient care; further, so much attention is not paid to the immersion of the cans of milk in cold water. For this last apparent neglect there is very good reason in the bad quality of the water which can be procured on most farms. Great efforts are being made to improve the quality of Friesland butter, and to restore it to its previous high standing in our markets, by applying the Swartz method of deep-setting the milk, and by using the most improved dairy implements in vogue in Denmark and Sweden. The want of good water, however, is a serious drawback, and I shall not easily forget the odour of the milk cellar at one of the best farms in Friesland, due entirely to the decomposing organic contents of the water in which the cans of milk were immersed.

A farm situated north-west of Leeuwarden, held by Mr. K. N. Kuperus, consists of 125 acres, all in grass. Thirty-six cows, with a proportionate number of young stock, are kept, and some of the best calves that can be found are bought, and reared chiefly on buttermilk and whey. He informed me that in 1879 his cows gave an average of 3850 litres (850 gallons) of milk in the year. Butter is made on the Danish system, the milk being skimmed the first time after standing 12 hours, and a second time after standing 24 hours. Skim-cheese is also made, and flavoured with cummin seed, the prices realised for it ranging from 34*s.* to 40*s* per cwt. The calves sold at a few days' old fetch from 12*s.* to 14*s.*, unless they are good enough to be kept

for breeding, when the price may reach as high as 30*s.* to 35*s.* The Americans buy a large number of cows from Mr. Kuperus, and he gets as much as 25*l.*, even now, for a good one. In winter the cows are fed on hay and linseed-cake ; and in the year 1880, although more than half of the land had been mown, the crop was so short that about 20 acres had to be mown a second time to enable the cattle to be kept through the winter. Labourers get in money 12*s.* 6*d.* per week from May 1st to November 1st, and 10*s.* per week for the rest of the year ; they also receive some bread and tea morning and evening at the farmer's expense, and during haytime are entirely fed by him. Cottages cost about 1*s.* 8*d.* per week, with a small patch of garden.

The farms in the immediate neighbourhood of Leeuwarden and some other parts of the clay-land district are entirely in grass ; but not far off, the prevailing system is about half grass and half arable. Thus, near Dronrijp, Mr. C. Sijtsma farms 50 acres of arable land and 62 acres of pasture, pays 333*l.* per annum rent, and half as much for labour, although three of his sons work on the farm. He keeps 20 milch-cows, 10 heifers, and 12 calves. The price of labour is the same as already stated by Mr. Kuperus.

In the south-western district of Friesland is the chief seat of the butter industry of the province, the head-quarters being the market-town of Sneek. Some changes in dairy-practices have recently taken place, in consequence chiefly of American competition. Thus the manufacture of skim-cheese has been reduced to very small proportions. Mr. Harmens, of Harlingen, a member of one of the largest firms of butter and cheese merchants in the province, told me, in October 1879, that he then had in his warehouse only between 400 and 500 cheeses, whereas a few years ago, at the same time of year, he would have had in store between 30,000 and 40,000. Butter-making, on the other hand, is increasing, and farmers manure their grass with the "terpen," to enable them to keep more cows. These "terpen" are peculiar to the provinces of Friesland and Groningen, and consist of hills where, it is said, the inhabitants took refuge in times of flood. Here also they lived in the winter, together with their cattle, before the sea-dykes were made. They are thus impregnated with the accumulated excreta of the old inhabitants, and are therefore very valuable as manure. I was told of one hill, 20 acres in area, and about 10 feet high, which had been sold for 4300*l.*, the soil at the natural level, after the removal of the hill, to become again the property of the vendor.

Butter Markets.—In Holland these are on a large scale during the season, and they are conducted on the same system in all the true butter-making districts. Thus at Sneek, in Friesland,

about 1000 casks are sold every market-day by what we call "Dutch auction," and about an equal quantity is consigned direct to the merchants and does not go on the market at all. This latter consignment is marked as to quality, cask by cask, by the merchants to whom it is consigned, and they pay for it at the price which the same qualities fetch by auction on the public market. Complaints are frequently made by the farmers as to the marking of their butter by the merchants, and these have recently led to the establishment of a Farmer's Association, of which there is a branch in most villages, and the members of which send their butter to the society's agent at the market-town for sale by public auction. This Association has acquired such strength in Friesland, that the merchants undertake to pay for direct consignments the same price that the farmers would have realised if they had sent their butter to be sold through the agency of the Farmer's Association.

Weighing on the market is done under the the supervision of Government officers, who also have jurisdiction over the construction and branding of the kegs. On an average each farmer sends his week's make to the nearest market-town, consisting of one or two kegs. In October, 1879, the price at Sneek was about 100*s.* per cwt. for fine butter, and I was told that on the London market it would fetch 134*s.*; the difference would cover freight, risk, commission, and merchant's profit.

Whey-Butter is made chiefly for household purposes, on farms where the principal object of the dairy is cheese-making. The whey is placed in large wooden tubs, and eventually skimmed, after having stood two or three days or more. The whey-cream is churned in the almost universal piston churn by the almost ubiquitous dog, and butter comes as a rule in about an hour and a half. Its after-treatment is the same as that adopted for cream-butter or whole-milk butter in the several districts.

The Dutch, at least the women, are proverbially fond of using water for cleansing purposes, and of spending a large portion of their time in scrubbing and otherwise cleaning everything that belongs to them. Their dairy utensils, with the exception of the copper milk-pitchers, are almost always constructed of wood, often with brass hoops. They are generally, *mirabile dictu*, painted blue outside and white inside, and the only probable explanation that I could find of the persistent use of so pernicious a material as paint by so practical a people as the Dutch, was, that it gave them abundant opportunities for exercising their ruling passion for scrubbing, which they really seem to regard as a kind of athletic sport. Vigorous efforts, however, are now being made by the Provincial Agri-

cultural Societies to introduce the improved dairy appliances used in Denmark, Sweden, and North Germany, but they meet with but slight encouragement from the farmers' wives.

Gouda Cheese.—The district in which this cheese is made is round the town of Gouda, not far from the Delft butter district in South Holland. Two varieties are made, one being of comparatively small diameter, and rounded at the circumference, known as the "Gouda" cheese, and the other, larger in diameter and flat at the periphery, known as "Derbyshire" cheese. The processes of manufacture are so similar and so simple that they can be described together.

The cows are milked morning and evening, and cheese is made twice a day, as soon as possible after each milking. The success of the cheese-making depends entirely upon the skill and experience of the farmer's wife or daughter, who is almost invariably the cheese-maker. The milk is put into a large wooden tub, and, if not warm enough for the rennet to be added, a certain amount of hot water is mixed with it, to bring it up to the required temperature. In one case, where a thermometer was used, this was stated to be 93° Fahr.; but this depends upon whether "Gouda" or "Derbyshire" cheese is to be made. In the former case the curd is not fit to cut until from 20 to 30 minutes after the rennet has been added, but for "Derbyshire" cheese it comes in from 15 to 20 minutes. The curd is cut with a native harp-like knife, made of stout wire, and also in some cases with a sharp English or American gang-knife. It is neither cooked nor salted, but is simply put into moulds and pressed for 24 hours. The cheeses are afterwards put into a salt bath strong enough for an egg to float in it, and then further surcharged with salt by a pile being placed on each cheese, as well as an additional quantity in the bath. "Derbyshire" cheeses remain in this bath from four to five days; but "Gouda" cheeses are kept in "pickle" from six to eight days, partly in accordance with individual practice, and partly according to the size of the cheese. The after-treatment of the cheese resembles very much our English practice.

The land is chiefly old polders, which have for many years been in permanent pasture. About one-tenth of the area is occupied by ditches, and the land is let at from 3*l.* to 4*l.* per acre. The richness of the land near Bodegraven is such that 2½ acres of land will keep a milch-cow all the year round, and in one case I was told that it carried two sheep as well. Some of the land is better adapted to fatten cast cows than to carry cows in-milk, and is used accordingly. About two-fifths of the land is annually mown, and the cows in winter are fed on the hay with an allowance of linseed-cake. Calves are sold very

soon after birth, and the herds appear to be generally kept up by purchases. Everything is subordinate to the making of cheese.

The best farmers keep from 24 to 30 cows and feed off annually from one-fourth to one-fifth of the oldest and least profitable. The farm-houses are of the true Dutch type, namely, dwelling-house in front with cow-stalls, stables, barn, &c., under the same roof in the rear. Cows are in two rows, heads to the centre, with drinking-troughs in front, and manure and urine-trough in the rear. The passage between the rows of stalls is very broad, and at the end of the steading is a detached Dutch barn exactly opposite the passage, and designed to store the hay in a convenient position for its conveyance into the cow-house. Many of the farmers are proprietors, and it is said that the majority of the tenants have been able to pay their rents, at any rate until those of 1879 became due, when many found a difficulty, and some could not overcome it. This arose chiefly from the low price of cheese, which in the autumn of 1879 touched as low a figure as 42*s.* per cwt., whereas in June 1880 it ranged from 52*s.* to 57*s.*, and even more. In fact, the variation in prices may be set down at about 20*s.* per cwt. Considering that the Gouda farmer sells nothing to speak of except cheese and cast cows, a depreciation of over 30 per cent. in the price of his staple product is very serious; indeed, unless he has a large reserve, it is simply ruinous. Until recently, the making of so-called "Derbyshire" cheese gained ground, as its shape and its less salty flavour enabled it to be sold as English. But the recent large consignments of American cheese have turned the tide in favour of what can be sold as real Dutch, and the farmers are now altering their practice back again to the native make. The first spring-made cheese is always so fat that it never becomes really hard, and this finds a ready sale in France. The best quality of hard cheese goes to England, and the worst, as a rule, finds its best market in Scotland. The cheese-merchants in this district evidently do a thriving business, and it is no fault of the farmers, their wives, or their children, if they do not make and save money. Blouses and sabots are the rule for everybody connected with the cheese business; and if the people have luxurious habits they are invisible to a foreigner, unless, it may be, their Sunday outings are subject to that reproach. Labourers are highly paid, as wages go in the Netherlands. They get 2*s.* 6*d.* per day in the summer and 1*s.* 8*d.* to 2*s.* in the winter, and they pay from 1*s.* 6*d.* to 1*s.* 8*d.* per week for their cottage, which, as usual, consists of one room and an outhouse.

In the Gouda district the dairy is generally a separate build-

ing from the farmsteading, but the cheese having been made is generally "pickled" and partly cured in cellars more or less beneath the dairy or the farmhouse. The cheese-room, properly so called, however, is in reality the cow-stalls during the period of the year when the cows are on the pastures night and day, that being the cheese-making season. A kind of bass matting is affixed to the pillars at the head of the cow-stalls, and where the cows stood in winter the cheese is stored in summer. In some cases, where dairy accommodation is not sufficient, the whole process of cheese-making is carried on in the cow-stall. Everything is kept scrupulously clean, and, in fact, in summer the cowhouse is generally abundantly decorated with bright copper and tin household and dairy utensils.

Edam Cheese.—The globular red-skinned cheese, generally called "Dutch" in England, is, beyond all question, the most important and the most distinctive dairy product of the country. It is chiefly made in the province of North Holland, but I have seen excellent specimens which were made in France, Russia, and elsewhere. The process is very simple, and the following description is the result of my own observation during an early morning tour in the rich grass-land district between Hoorn and Enkhuisen, where proprietor-farmers prevail. The farms are about 50 acres in extent, and from 15 to 18 cows are kept. The cows are milked morning and evening, the milker finding his way to them in a boat, which also carries the cheese-tub and the rennet in addition to the milk-cans and other necessary articles. As soon as the cows are milked, the rennet is added to the mess in the cheese-tub, and the milker gently paddles home his freighted boat. By the time he arrives at the farmhouse, the curd is about ready for the remainder of the cheese-making processes to be proceeded with.

In a dairy of 15 cows, about 10 or 11 cheeses would be made on an average every day, one half in the morning and the remainder in the evening. In the case of an odd number, the small quantity of curd left over would be kept until the next milking, and added to the curd then obtained. Very few farmers use a thermometer: but those who do, reckon to put in the rennet at a temperature of about 90° Fahr., or perhaps a little less. The curd is not cooked, but in from 15 to 20 minutes after the rennet has been added it is cut with a harp-like wire gang-knife, and the whey is baled out as completely as possible, being finally got rid of by tipping the cheese-tub after the curd has been consolidated together as much as possible by the hand. The process of baling entails no loss of curd, but that of tipping does, and this is counteracted by pouring the last of the whey through a sieve, which retains the particles of curd. The curd

thus remains in the tub as a cut but pressed mass, which is then re-separated into its component pieces by working with the hand, no curd-mill being used. It is then put into globular moulds divided into halves, and is pressed together as much as possible to get out the remaining whey. Afterwards the young cheese is enveloped in linen or other cloth, and placed in smaller moulds, which are subjected to pressure for 24 hours. After this process the cloths are taken off, and the cheeses are placed in semi-globular cups, in which they are turned upside down every day, after which operation a handful of salt is placed on the top of each. They remain salted in this way seven or eight days, and some makers salt them even ten days. The cheese-press in general use is of the lever-type, but it is in this district a most elaborate piece of furniture, carved, painted, and polished to a wonderful extent. Before the cheeses are sent to market they are soaked in tubs of clean water to cleanse them, and are then rubbed over with linseed oil. The outside colouring is done by the merchants, but annatto is used in the cheese-making process.

As an example farm of a high class, I may take that of Mr. Sluis, who has 125 acres of land, only about 11 or 12 being in arable cultivation. Half the grass is mown and the other half fed in summer, every year in rotation. Thirty milking-cows are kept; from 12 to 14 of the best calves are reared annually (the remainder being sold at a month old); and between 10 and 20 cast cows and oxen are fattened every year on the grass, with the following somewhat curious scale of allowance of artificial food:—First month, 2 lbs. of linseed cake per head daily; next three months, 4 lbs. of linseed cake per head daily; and afterwards, for another month, 2 lbs. per head daily. Edam cheese is made with the milk; from 15 to 17 per diem were being made at the time of my visit in October 1879. The cheeses weigh about 4¼ lbs. each, and the price at that time was 57*s.* 6*d.* per cwt., but the previous year it was only 52*s.* About 40 Texel ewes, crossed with Lincolns, are also kept. They generally give a crop of 60 lambs, which are sold fat at 18 months old, realising in 1879 about 50*s.* a-piece, but in 1878 from 60*s.* to 66*s.* In addition, these shearlings give from 10 to 12 lbs. of unwashed wool each. The labourers on this farm were two men and two women, living in the farmhouse, and four living in cottages. Of the former, the men received nearly 12*l.* and the women 10*l.* per annum and their food. The outdoor labourers earned about 16*s.* 8*d.* per week in summer, from April to November, and 11*s.* 8*d.* per week for the rest of the year. The rent of a cottage is from 2*s.* 6*d.* to 3*s.* per week. All these figures are extraordinarily high for the Netherlands,

but the general rule of a day's wages paying the week's rent of a cottage is almost, but not quite, maintained.

Mr. Sluis may be cited as a favourable example of the better class of Dutch farmer. With 112 acres of grass, 12 or 13 of arable land, 70 head of cattle or thereabouts, and 100 to 160 sheep on the farm, making cheese twice a day, he has six men and two women servants, with his wife and family, and his own aid and supervision to do the work. Although he speaks no foreign language, he has twice been to England for the purpose of seeing the shows of the Royal Agricultural Society of England, namely, at Wolverhampton in 1871, and Hull in 1873; and he purchased on these occasions several agricultural implements by the best makers, especially mowing-machines, horse-rakes, and hay-tedders. He has also been to Denmark to study the Swartz system of setting milk, and he bought there the milk-cans and other apparatus necessary for setting milk at a low temperature. His house, as is usual in North Holland, and indeed in most parts of the Netherlands, is under the same roof as the cow-stalls, stables, and hay-barn. Everything was not only scrupulously clean at the time of my visit in October 1879, but what with finely-raked sand over the tesselated pavement of the cow-stalls, the matting over the glazed trough which, in the winter, while the cows were in the stalls, carried away the urine, the lace curtains to the small windows, each of which lighted its own particular cow-stall, the rows of globular cheeses undergoing the process of curing, the dairy utensils polished and scrubbed up to the zenith of brightness and cleanliness, one was forcibly reminded of M. Havard's description of a North Holland homestead, which was borne out by the presence of Mrs. Sluis and her daughters in the *salon*, and, I hope, also by the condition of Mr. Sluis's banking account.*

Co-operative Dairying.—Several farmers in the Hoorn dis-

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* "Vous connaissez de réputation ces merveilleuses étables, carrelées de faïences et sablées de différentes couleurs, plus propres qu'un salon, où l'on ne doit ni fumer, ni tousser, ni cracher, dont on ne peut fouler le sol, sans avoir au préalable chaussé de gros sabots blanchis, et dans lesquelles les belles vaches, blanches et noires, symétriquement rangées sur des litières toujours fraîches, ont la queue attachée au plafond, de peur qu'en des moments délicats, elles ne viennent à se barbouiller. Hé bien, c'est dans ces jolis hameaux qu'on les trouve, ces étables incomparables, avec leur arsenal de seaux, de brocs et de pots, brillants, polis, luisants à faire croire qu'ils sont d'or ou de vermeil.

"Quelquefois, au bout de l'étable, vous apercevez un salon avec de belles et fraîches jeunes filles, aux grands bonnets, au casque doré, travaillant à quelques menues fantaisies ou tissant de charmantes *frivolités*. C'est que beaucoup de ces paysans sont des millionnaires enfermés dans leur fromages, vivant avec une large simplicité, sans préoccupation dans l'esprit, sans passion dans le cœur, ignorant ce qui se passe au loin, peu soucieux de ce qui se fait auprès, et entassant chaque année des piles d'argent sur des piles d'or."—'La Hollande pittoresque: Voyage aux villes mortes du Zuiderzée,' par M. Henri Havard, 2me édit., pp. 124 and 125.

trict have joined together to establish at Tochthuis a butter and cheese factory, and to test the applicability of the Swartz system to their local circumstances. They have hired a building and engaged for six months a North German dairymaid, and they buy milk from the surrounding farmers at the low price of six cents per litre (in June), this being equivalent to not quite 5½*d.* per gallon. At the time of my visit, in June, they had found that the water at their command was not cold enough to enable them to carry out the Swartz system in its entirety; therefore they had substituted flat pans immersed in the water for the deep cans used by Mr. Swartz and his followers. Skim-cheese was made in the Edam shape, but larger, and the rennet was added to the skim-milk at a much lower temperature than when whole-milk is used to make real Edam cheese, viz., 78° to 80° Fahr. instead of 90°. Nevertheless these cheeses were being sold, as I was informed, at 60*s.* per cwt., when the whole-milk cheeses were making not more than 70*s.* At that date (June 11th, 1880) cheese was very dear, whereas the previous autumn it was excessively cheap. All the best Danish and German dairy utensils were in use, except false-bottomed cheese-tubs, the milk being brought to the required temperature by warming a portion in kettles. The chief interest of this experiment lies in the fact that it was instituted and carried on entirely by small proprietor-farmers, having rarely more than 20 cows each, as it presents unmistakeable evidence of their desire to take advantage of any improvement in dairy practice, and to join in putting it to a proper test before committing themselves to its adoption.

Co-operative Factory at Leiden.—A co-operative dairy factory on a considerable scale exists at Leiden. Last October (1879), when I visited it, the manager was receiving over 1100 gallons of milk per day, but in May between 1500 and 1600 gallons are sent, these quantities representing, it is said, the produce of about 600 cows. The price paid is the same as at Tochthuis, viz., nearly 5½*d.* per gallon. A small quantity is sold in the town at nine cents the litre, or about 8*d.* per gallon, delivered at the houses. Butter and skim-cheese are made with the bulk of the milk, except that the production of the latter is restricted by the right of the purveyors of the milk to purchase the skimmed article at the rate of about ½*d.* per gallon (200 litres for a guilder). The farmers who supply the milk keep on the average from 20 to 40 cows each, and it is found that the milk yields about 3 per cent. of its weight of butter and 7 per cent. of skim-cheese. The butter was said to be selling at about 1*s.* 4*d.* per lb. last October (1879), and the price of skim-cheese was quoted at 4*d.* to 4½*d.* per lb.

Co-operative Cheese Factory at Winkel, North Holland.—This

is a joint stock company called "the Wieringerwaarder Maatschappij tot bereiding van Kaas." It receives the milk of about 160 cows from eight contributors, who skim the evening's milk in the morning and mix it with the unskimmed morning's milk, sending the mixture to the factory, where it is made into Edam-shaped cheese, which last October (1879) was said to be selling at about 50*s.* per cwt., or rather more than 5*d.* per gallon of milk. According to the rules passed in 1872, the contributors were to receive five cents (1*d.*) per kilo for their milk, or not quite 5*d.* per gallon; this price was to be paid in two instalments, viz., three-fifths every fortnight and two-fifths at the end of every quarter. Cheese is made twice a day in vats of the square American pattern. The rennet is added at a temperature of 84° Fahr., and the milk is left for an hour. The curd is then cut by gang-knives, first vertically, then horizontally, and then transversely, as thoroughly as possible, and is then cooked up to 94° Fahr. About 80 cheeses, weighing two kilos (4½ lbs.) each, are made daily in October, but of course the number varies with the time of year and the character of the season.

XXX.—*The Berkshire Farm Prize Competition*, 1882. By J. H. Blundell, Woodside, Luton, Bedfordshire.

"The daily blessings received by mankind from the hand of Agriculture, and the increased comfort and wealth which every nation enjoys where husbandry is improved, are in themselves reasons, sufficiently urgent, to engage the attention of every person, who has the power of promoting its extension."—Mr. Pearce's *Report on Berkshire to the Board of Agriculture*, 1794."

Reading, the capital town of the Royal County, being the site selected this year for the Country Meeting of the Royal Agricultural Society, the Local Committee offered the handsome sum of 225*l.*, in four Prizes, for the best cultivated dairy, arable, or mixed farms in the county, or situated wholly or in part within a radius of 20 miles from the Town Hall of Reading. The Prizes were divided into two classes, viz. Class 1, for the best managed Farm above 200 acres in extent, 100*l.*; for the second best, 50*l.* Class 2, for the best managed Farm above 50 and not exceeding 200 acres, 50*l.*; for the second best, 25*l.* The public spirit, as evidenced by the liberal subscriptions from which this fund was raised, recalls the time when—

"Far back in the ages,
The plough with wreaths was crowned;
The hands of Kings and Sages
Entwined the chaplet round;

Till men of spoil disdained the toil
By which the world was nourished,
And dews of blood enriched the soil
Where green their laurels flourished:
Now the world her fault repairs—
The guilt that stains her story;
And weeps her crimes amid the cares
That formed her earliest glory.
—The glory earned in deadly fray,
Shall fade, decay, and perish.
Honour waits, o'er all the Earth,
Through endless generations,
The art that calls her harvests forth,
And feeds the expectant nations."

The competition was limited to tenant-farmers paying a *bonâ fide* rent for at least three-fourths of the land in their occupation, the whole to be included in the certificate. Fourteen competitors entered the lists, only one of these being in Class 2, and two only outside the county of Berks. Before the Judges commenced their inspection, one competitor in Class 1 withdrew from the contest, leaving an area of about 5000 acres to be visited.

The occupations may all be described as mixed farms, the proportion of grass to arable land varying from an eighth to two-thirds, as set forth in the respective certificates of entry, the particulars of which are given in the annexed schedule.

Before entering upon a detailed account of the farms, it may not be out of place to make some general remarks on this interesting district.

Historically, Berkshire occupies a prominent position among the counties of England. The stately pile of buildings embraced under the name of Windsor Castle, and so long a chief residence of our monarchs, has justly entitled the county to the appellation of Royal. It was at Wantage in this county that our great Saxon King, Alfred, was born, and here at Ashdown he broke the power of the invading Dane, and in the "White Horse" engraved upon the sward of his native hills has left an enduring monument of his prowess, and given a name to one of the most fertile valleys of our country. Windsor Castle was the birthplace of Edward III. and Henry VI., and at Reading Abbey, Henry I. and his daughter, the Empress Matilda, mother of our Henry II., found a sepulchre. From the time of the Roman occupation to the strifes of the Commonwealth, Berkshire has frequently witnessed and suffered from the ebb and flow of war. Mr. Walford, in his 'Guide to Berkshire,' speaks of the town of Wallingford as one "which has grown up on the ruins of the old settlements of the Britons, the Romans, the Danes, and the Saxons." Of the old castle here little remains,

beyond a few fragments of the walls, the structure having been demolished by the Parliamentary army during the Civil Wars. It was in the collegiate chapel of this castle that Thomas Tusser, the author of 'Five Hundred Points of Good Husbandry,' was a scholar and chorister about the year 1520, and of whom Fuller says, "he was successively a musician, schoolmaster, serving-man, husbandman, grazier, poet; more skilful in all than thriving in any vocation. He traded at large in oxen, sheep, dairies, grain of all kinds, to no profit. Whether he bought or sold, he lost, and when a renter, impoverished himself, and never enriched his landlord. Yet hath he laid down excellent rules in his book of husbandry (so that the observer thereof must be rich) in his own defence. He spread his bread with all sorts of butter, yet none would stick thereon, none being better at theory, or worse at the practice of Husbandry." Lord Molesworth, in his 'Considerations for Promoting Agriculture, 1723,' says, "As to agriculture, I should humbly propose that a school for husbandry were erected in every county, wherein an expert master of the methods of agriculture should teach at a fixed salary, and that Tusser's old 'Book of Husbandry' should be taught to the boys to read, to copy, and to get by heart, to which end it might be reprinted and distributed. I doubt not but that some such method as this would make husbandmen, and prevent the increase of the poor." Tusser's book, first printed in 1557, passed through more than twenty editions before 1700. Dr. Mavor, an honorary member of the Board of Agriculture, who published a new edition of the work in 1812, remarks, "Happy should I be to find that my labours have in any degree contributed to realise the speculations of Lord Molesworth." The writer of this Report cannot help thinking that the want of skilful and trained workmen is likely to become more and more a difficulty with English farmers of the present day; for, as Tusser quaintly puts it:—

> "Good shepherd, good tillman, good Jack and good Gill,
> Make husband and huswife their coffers to fill."

In various other branches of industry technical schools have been established, to keep pace with the competition and growing requirements of the times; and to my mind, the question of formulating a scheme for training boys in rural districts, to qualify them for agricultural employment, is one of the most important that can engage the attention of the Royal Agricultural Society of England.

Berkshire has also produced a distinguished author on agricultural affairs in Jethro Tull, who at Prosperous Farm, in the parish of Shelbourn, practised and wrote upon improved

methods of husbandry, and to whom we are indebted for the introduction of seed drilling in place of the old fashion of broadcasting.

Berkshire is one of the smallest counties in England, containing, according to the Board of Trade Returns, only 450,132 acres; and yet it possesses great diversity of soil, the larger portion of which is of considerable natural fertility, owing in a great measure to the influence of the Thames and its various tributaries. This noble river forms the boundary of the county between Gloucestershire, Oxfordshire, and Buckinghamshire for upwards of a hundred miles. The climate is considered one of the most salubrious in the kingdom. The rainfall for a series of years averages from 22 to 23 inches.

The principal hills are of chalk formation, attaining on the White Horse range an elevation of 893 feet; and at Inkpen Beacon, near Hungerford, is found the highest point of chalk in the south of England, viz. 1011 feet, and the whole county appears to lie over chalk or limestone. The Castle of Windsor is reared on a solitary eminence of chalk, here rising above the stiff clay, which in this neighbourhood is said to be over 300 feet deep.

Under the Vale of White Horse, where the richest soils occur, the chalk runs into a harder limestone, of a blue colour, and a kind of freestone. Along the Thames is a belt of rich meadows, nowhere extending over two miles in width. The Vale of Kennet is perhaps next in importance to that of the Thames, and is well adapted to the growth of corn. The soil is gravelly, overlaid with loam. This valley also contains a considerable tract of water-meadows. In the locality of Newbury is found a species of peat, in some places only 18 inches below the surface, and in others as much as 4 or 5 feet, the stratum varying in thickness from a few inches to several feet. This deposit rests upon an uneven bottom of gravelly loam. This river is described by Pope as—

"The Kennet swift for silver eels renowned."

The writer quoted at the head of this article remarks:—"The predominant soil of Berks is a kind and fruitful loam, in some parts mixed with gravel, and in others with sand: pleasant to work, and grateful in its produce."

Owing to the forwardness of the climate, the harvest of Berkshire appears to have suffered less from the rain of August last year than that of many other counties; and the samples of corn we inspected were generally in fine condition, instances being met with of barley realising 50*s.* per quarter, and of wheat weighing 66 lbs. per bushel. At the same time the excessive wet and un-

genial seasons of the past four years have materially affected the stiff, cold, low-lying lands, by reducing their fertility and affording no regular opportunity for thoroughly cleaning the land; and this has only been accomplished by the display of great energy in seizing upon and making the most of the few favourable intervals for such purposes.

The production of milk in Berkshire has been considerably extended, and the sale of it forms a very important item in the receipts of those farms where it is cultivated. It would appear from the Agricultural Returns that cattle are slightly increasing in numbers; the breed most in repute being large-framed animals of good Shorthorn type. Sheep, according to the same returns, have decreased from 1880 to 1881 by 18,220, and statistics recently published in the 'Times' give the reduction of sheep in thirteen years, 1868 to 1881, as 113,000, or approximately one-half the total number of sheep now in the county: and this reduction has taken place, notwithstanding an extended area of sheep-producing crops within the same period of 21,000 acres, and an advance in the price of mutton of $2\frac{5}{8}d.$ per pound.

The Judges arranged to start on their first inspection on Monday, December 12th, but Mr. Long was unable to accompany us owing to a severe attack of illness, and consequently on that occasion we were deprived of the benefit of his experience acquired by similar engagements in the Fen and other districts. Mr. Parsons and the reporting Judge, however, met at the Great Western Hotel, Paddington, on the evening of the 11th, and left by the first train the following morning for Slough, to commence our labours. The week before St. Thomas's Day is not the most agreeable time for examinations of the kind we had undertaken, yet, upon the whole, we were highly favoured in the weather, and were able "with narrow search and with inspection deep" to survey the fallows, roots, and newly sown wheat, and estimate the winter management of the live-stock. The whole of the arable land was walked over, except the last field on the Saturday afternoon, whence we were driven by a perfect hurricane of wind and rain, which, in spite of umbrella and macintosh, bid defiance to our advance. Our exertions during the day made the repose of the evening most enjoyable, when, divested of muddy boots and outer garments, we had leisure to refresh exhausted nature and quietly review the lessons of the day; probably the least pleasant part of our experience was the inevitable "Quarter to six, sir," from the porter in the morning, and the start for our destination, with the stars still shining through the frosty air, or the prospect obscured by a cold drizzling rain.

Schedule of Competing Farms.

Class.	Name.	Address.	Acreage.	Arable.	Grass.	Soil.
1	Adams, George	Pidnell Farm, Faringdon	1082	387	695	Clay, gravel, and sand.
	Armstrong, T. W.	Bow Lane Farm, Dunsden, Reading ..	301	215	86	Chalk, clay, and loam.
	Auckland, George	Warfield, Bracknell, Wokingham ..	290	145	115	Strong yellow clay.
	Byng, Admiral John C.	Haines Hill, Twyford	215	140	75	Chalk, gravel, and clay.
	Cotterell, Executors of late H.	Ruscombe, Twyford	391	296	95	Clay and chalk.
	Cundell, Matthew Henry ..	Coley Park, Reading	250	80	170	Gravel.
	Davies, Jenkin	Wickcroft Farm, Englefield, Reading	323	219	104	Gravel.
	Lay, James	Siege Cross Farm, Thatcham, Newbury	250	180	70	Clay and gravel.
	Lee, George	Hall Place Farm, Maidenhead	430	340	90	Chalk and clay.
	Medcalf, Jabez	King Street, Wokingham	381	251	133	Clay and gravel.
	Ratcliff, James John	The Priory, Beech Hill, Reading ..	220	110	65	Clay and gravel.
	Twinch, John	Cippenham Lodge, Slough	409	219	160	Gravel and loam.
	Wells, Alfred Dodd	Sotwell Hill, Wallingford	630	520	110	Rubble and clay.
2	Clutterbuck, Rev. James C. ..	Vicarage, Long Wittenham, Abingdon	123	106	17	Gravel and clay.

On our second visit all the Judges met at Reading on the 17th of April, and spent seven days in going over the competing farms. The final examination began on the 28th of June, and was confined to those occupations we had selected from which to make our award.

It would be impossible to write a report connected with the Agriculture of Berkshire without reference to the Royal Farms, occupied by her most gracious Majesty, who in this, as in all departments of life, exhibits such an illustrious example to her people.

A retrospective view of the agriculture of our country shows what great advances have been made during the present century. The unpropitious seasons of the past few years have doubtless inflicted most serious loss on both owners and occupiers of land, and checked the spirit of enterprise in the cultivators of the soil. Yet periods of equally great agricultural depression have before this occurred and have been surmounted.

First Prize, Class I.

Mr. J. J. Ratcliff, The Priory, Beech Hill, Reading.

This farm contains 220 acres, viz., 140 arable, 65 grass, and 15 acres of wood; it is held on lease from Eton College, and lies seven miles south of Reading.

The soil is described in the certificate of entry as heavy, with a subsoil of clay and gravel; from the geological map it appears to be on the London clay formation.

On the north-west and south-west the farm is contiguous to the Strathfield Saye estate, and on the south-east is bounded by "The Loddon slow, with verdant alders crowned," and towards which most of the land gradually inclines.

Our first visit was on the 14th of December, when we found all the arable land ploughed and ridged up in lands of 8 feet 3 inches wide, in thoroughly workmanlike style, the water-furrows neatly cut, the wheat sowing completed, and all outsides and corners cleaned and finished, while a most careful examination failed to detect any couch; indeed a garden could not well be more free from weeds or rubbish.

The course of cropping adopted on that part of the farm nearest the homestead is as follows: wheat, barley, trifolium or mangold, sometimes varied thus; wheat, beans, cabbage and turnips.

At the far end and heavier portion of the farm the rotation is beans, wheat, oats or barley, trifolium or tares fed off. All the wheat is of the Rough Chaff variety, the drilling of which commenced on the 20th of October, and was completed the 9th of

November. Nine pecks of seed is the quantity per acre, in rows $8\frac{1}{4}$ inches apart, or 12 rows on each land, none being drilled in the furrows. The barley is Webb's Pedigree Selection, and the oats White Waterloo; the latter received 30 bushels of soot per acre.

Three kinds of trifolium are used, the early and late red, and late white, with a seeding of from 30 to 40 lbs.

Spring beans and maple peas are drilled 14 inches apart, the former at the rate of 3 bushels, and the latter at $3\frac{1}{2}$ bushels per acre.

For mangolds the ground is prepared by once ploughing and subsoiling, with a heavy dressing of farmyard-dung, 6 cwt. of bones, and 3 cwt. of salt.

Cabbage and turnips are dunged for in the same way, and get an extra ploughing in lieu of subsoiling; and home-made compost from earth-closets and hen-houses is drilled with the seed.

The crops this year consist of 52 acres wheat, $8\frac{1}{2}$ barley, 9 oats, 15 peas, 12 spring beans, 19 vetches and trifolium, $10\frac{1}{2}$ mangold; and $12\frac{1}{2}$ swedes, turnips, and cabbage, in about equal proportion.

Nine acres of wheat on the heavier land at the most remote part of the farm follows a previous crop of the same grain; this has been done to equalise the acreage and bring it into rotation. To meet the case, a crop of mustard had been ploughed in, and 30 bushels of soot applied, and it had been twice hand-hoed. This crop was somewhat root-fallen, detracting in this instance from the level abundance presented by all the other wheat, and which Mr. Ratcliff regarded with commendable pride and satisfaction.

The spring beans and maple peas were of most luxuriant growth, full of blossom and kids, free from fly and remarkably clean; at the time of our second visit on the 20th of April, they were undergoing a hand-hoeing at 5*s.* per acre, after which the vigour of the crop was quite sufficient to prevent the growth of weeds. The barley was a nice upstanding crop with lengthy ears, and the oats looked strong and robust with an appearance of quality.

Trifolium and vetches were heavy crops; the cutting of the former for cattle commenced on the 10th May, and continued up to July 15th; on our last visit the land, from which $6\frac{1}{2}$ acres had been consumed in this way, was broken up, scarified, and cleaned ready for a crop of white turnips.

The early drum-head cabbage had made rapid growth from April 20th to the time of our last visit; and the swedes and white turnips at that time were about all set out singly, showing

every promise of abundant feed. Mangolds were fairly forward, but from some cause, inexplicable by Mr. Ratcliff, were not a perfectly regular plant, and had been filled up by transplanting.

The whole of the grass-land is mown for hay, and receives in rotation a dressing of 4 cwt. of bones per acre. The meadows lie on the bank of the Loddon, and at the commencement of Mr. Ratcliff's tenancy were intersected by open ditches, in which water constantly stagnated; these have been filled up with pipes 20 inches deep, draining into the river, the surface has been levelled, and now, in place of the former sour grass and rushes, is found a thick sward of sweet and nutritious herbage. For such a season Mr. Ratcliff was singularly fortunate in securing his hay; the carting was being completed at the time of our last inspection on the 28th June.

Mangolds and swedes are drawn off the land for consumption by cattle. The mangolds of last year's growth we found of large size, superior quality, and carefully stored.

The sale of milk by contract to Messrs. Huntley and Palmer's biscuit factory is one of the main sources of income from the farm, realising last year nearly 1000*l.*, and a grander lot of Shorthorn dairy cows than those from which the supply is obtained would be difficult to find in any county.

The cows are kept in an admirably arranged, well ventilated, and roomy house, having a wide central pathway from which the animals are fed. The winter food consists of a liberal allowance of bran, pea-hull, grains, and mangolds mixed with cut chaff; this is prepared in a conveniently adjoining shed.

The cows are not turned out to grass until the rowen is ready, but trifolium and vetches are brought to them in the shed and yards, upon which they appear to thrive and milk well.

Two bulls are in use in the herd; "Grandee," a remarkably massive animal of fine quality, bred by Messrs. Leney and Son from a cow of the Knightley strain, so well known for milking properties, and "Priory Duke," a handsome straight two-year-old, from one of Mr. Ratcliff's best cows. The herd is replenished by weaning the most promising only of the female calves. Bull calves, and those not of the favourite roan colour, or approved form, are sold at a few days old, and realise about two guineas each.

The pigs are capital specimens from the best strains of the excellent native breed of blacks, with white terminals. The youngsters, well kept from birth, until they attain a weight of from 65 to 80 lbs., then find a ready sale as London porkers at about 8*d.* per lb.

These useful creatures are housed in dry, comfortable, and airy quarters, with well paved and drained outside courts. The

piggeries are kept sweet and clean by frequent lime washings on the inside, and the application of gas-tar to the outer fences, and, as well as the cattle-sheds, by the daily use of ground gypsum.

The farm horses are active short-legged animals, well suited to the land; one or two foals are bred yearly. The denizens of the poultry-yard, like the other live-stock, receive careful attention, and show Mr. Ratcliff's appreciation of good blood.

From the unsuitable nature of the soil for winter folding, no sheep are kept during that season of the year, but are bought in as required, and fed off on summer keep such as trifolium, vetches, and white turnips; those we saw on our last inspection were 120 good-framed crossbred shearlings, with a remote foundation of the old black-faced Norfolk blood; they were in thriving condition, and receiving a pound and a quarter of linseed-cake per diem.

The live-stock varied but little on each visit; on the 20th of April we found

38	Cows in-calf or in-milk.	10	Working horses.
2	Bulls.	4	Colts.
1	Fat show heifer.	11	Sows.
1	Fat steer.	1	Boar.
6	Year-and-half-old heifers.	60	Pigs.
2	Weaning calves.		

Mr. Ratcliff has on several occasions been a successful exhibitor of cattle, and with "Priory Princess," a Shorthorn heifer of his own breeding, carried off the Champion Prize at the Smithfield Club Show in 1879, the same animal winning at Birmingham the first prize in the heifer-class under four years old, she being then three years and four months old, and her live-weight only a few pounds short of a ton. After her victory at Islington, "Priory Princess" was sold for the shambles for 150*l.*, her dead weight reaching over 1560 lbs.

At the present time Mr. Ratcliff has in training for Islington a roan three-year-old Shorthorn heifer, and a well-grown yearling steer.

Before leaving the live-stock, mention must be made of the half-dozen beautiful roan heifers, of about a year and a half old; these in their yard with its roomy shed form quite a picture, with their broad backs, well-sprung ribs, and stylish countenances, and bid fair to make a valuable addition to the milking herd.

The expenditure last year for feeding stuffs, other than those grown on the farm, or used by horses, amounted to 650*l.*, and that for artificial manures, viz. bone-dust, guano, and nitrate of soda, to 125*l.*

The labour-bill, somewhat heavy, as might be expected with such high-class cultivation and such a large amount of hand-fed stock, comes to 36*s*. per acre. On this head Mr. Ratcliff remarked, "you will perhaps think this high, but looking at the results, and considering the farm had been very much out of order previous to my occupation, I think you will say the money has been well laid out, and I am sure of one thing, that it will not require so much in the future." And the Judges feel bound to place on record that they were quite unable, after a severe scrutiny, to find any instance of unnecessary or extravagant expenditure.

The bailiff's house and two cottages are well placed near the farm-buildings; two other cottages form a lodge entrance to the estate.

The farm buildings are well-arranged and commodious, and the greatest neatness and order pervades the whole.

The roads on the farm are well constructed and admirably kept, that dividing the arable from the meadow land being furnished with gratings at frequent intervals to receive and convey into the adjoining brook the overflow from the land. All the gates are well-painted, the fences neatly trimmed, the ditches thoroughly scoured, and outlets made good; and all this not of yesterday, but part of a system evidently adopted for years.

The implements are of the best kinds, and those found most suitable to the land; they are well preserved when not in use in a covered shed, and include a manure-distributor, as well as a corn-mill, chaff-cutter and pulper, driven by a new and excellent eight-horse-power portable engine, which also does the threshing.

The Priory House faces the Loddon valley, with a picturesque woodland landscape, and is a large old-fashioned structure thoroughly adapted for comfort, with the whole of its appointments in elegant taste. Charming pleasure-grounds, and a most productive kitchen-garden run down to the river, where pike, roach, dace, and perch afford excellent sport to the followers of "Walton," and where otters are said to abound.

We are pleased to understand that Mr. Ratcliff has arranged for an extension of his lease, and trust that he may long live to realise the quiet enjoyment of his country home, and find in the return made by the farm a reward for his enterprise and outlay. Mr. Ratcliff entered upon the farm in 1875, and the standard he set himself was to double its production; in the attainment of this laudable endeavour he has judiciously invested capital in permanent improvements, under which head may be mentioned draining, chalking, erection and mainte-

nance of suitable buildings for stock, purchase of artificial feeding-stuffs, grubbing up useless fences, and reducing to the narrowest limits those left. No part of this outlay could be regarded as of a fanciful or amateur character.

In addition to this occupation, Mr. Ratcliff has an extensive business in London, so that his time at the Priory is limited; and the highest praise is due to him, that under these circumstances he has, by dint of great judgment and energy, brought his farm into such admirable condition as makes it an example to the whole district; taking therefore into consideration the general management with a view to profit, the extraordinary productiveness of crops, the marked excellence of the live-stock, the management of the grass-land and dairy produce, and the perfect state of neatness of gates, roads, and fences, points particularly alluded to in our instructions, the Judges unanimously awarded the first prize of 100*l.* to Mr. Ratcliff.

Second Prize, Class I.

Mr. George Adams, Pidnell Farm, Faringdon.

The extent of this occupation is 1082 acres, consisting of 387 arable and 695 grass, and is held on a yearly tenancy from Col. Sir R. Loyd Lindsay, K.C.B., M.P., D. Bennett, Esq., T. H. Southby, Esq., and Oriel College, Oxford; and 80 acres are owned by Mr. Adams.

The soil is described as clay, gravel, and sand.

The Pidnell farm, where Mr. Adams resides, and the other adjoining occupations, resting on the Oxford clay formation, are distant two miles north of Faringdon, and the land lies to the right and left of the road leading from there to Burford.

The Thames is the boundary on the north, and is here crossed by Radcot Bridge, famous as the scene of the battle in 1387 between Henry IV., then Earl of Derby, and the Earl of Oxford.

The acreage of the crops on the whole of the farms is 97 wheat, 40 barley, 21 oats, 65 beans and peas, 20 vetches, 31 mangolds, 42 swedes, 9 cabbage, 10 turnips, 31 grass seeds. The wheat is of the Golden Drop, Rivett's, and Square-head varieties.

The usual cropping on the Pidnell and Thrupp farms is wheat every other year, alternating with roots, beans, and peas, clover, rye-grass, or vetches, a crop of barley or oats being taken occasionally after roots instead of wheat. The barley is of the awnless kind, and being stiff in the straw is less liable to lodge.

Three bushels of this grain is sown per acre, and two bushels of wheat.

Some of Mr. Adams' land is on a level with the Thames, and during the past four years has been frequently flooded, and appears to be still suffering from the effects of too much water; consequently the corn in places had a sickly appearance contrasted with the generally full and healthy crops. Owing to the same cause Mr. Adams had been unable to eradicate all the couch: with suitable weather in the autumn an early smashing by steam would probably be highly beneficial in cleaning the ground.

Spring beans and peas, sown together the first week in March in rows twelve inches apart, looked strong, and promised a good yield; the winter beans, in consequence of the mildness of that season, had made a too vigorous growth, were thicker than consistent with productiveness, and had run up to a height of six feet; seven acres of this crop, badly blighted, had been mown in June, and the land was to be cleaned ready for a crop of rape.

The sowing of mangolds was going on at the home farm at the time of our second visit on the 18th April; a water drill depositing 7 lbs. of Sutton's Golden Tankard seed per acre, and 3 cwt. of superphosphate, on land previously prepared by a good coating of dung, and 4 cwt. of salt per acre. On our last visit this crop nearly covered the ground, and had been twice hoed at a cost of 10*s.* per acre. Cabbage were planted next the mangolds with every prospect of giving a large amount of valuable food, and a narrow corner bore a crop of prickly comfrey, from which two or three crops had been already cut.

With such a large proportion of grass-land the hay harvest is an anxious time with Mr. Adams, who appears to have an admirable arrangement for its ingathering.

The cutting is let to the men at 10*d.* per acre, machine and horses being provided, and this price includes mowing by hand round the field and under trees; 1*s.* 3*d.* an acre is paid for pitching and loading, the same price for making stack bottoms, building, pulling, and topping up; and 4*d.* per acre for raking. Women and tedding machines are employed in making the hay, and an elevator is used for stacking.

In harvest the wheat and oats are cut by hand and tied at 11*s.*; beans at 10*s.*; and the carrying costs 2*s.* 9*d.* per acre.

Wheat and beans are paid for at the rate of 4*s.* per acre for each hoeing; swedes at 4*s.* 6*d.*; and ditching is done at 1*s.* 3*d.* a chain.

The annual cost of labour is 29*s.* 8*d.* per acre on the Pidnell farms, and at the Lodge it will this year amount to 35*s.* Carters get 14*s.* per week, stockmen the same, while ordinary labourers receive 12*s.* a week.

Mr. Adams has nineteen cottages on his farms: these are let to the men at the very moderate rent of 1*s.* to 1*s.* 6*d.* per week. We were pleased to find that a friendly feeling evidently exists between employer and employed.

Before dealing with the off-lying farm, or the live-stock, reference should be made to a capital arrangement suggested and carried out entirely by Mr. Adams, whereby the sewage from the town of Faringdon is intercepted, and made to flow over some of the meadows instead of entering the river; this has obviated the otherwise necessary outlay of a considerable sum by the local authorities, and has also increased the production of Mr. Adams' land.

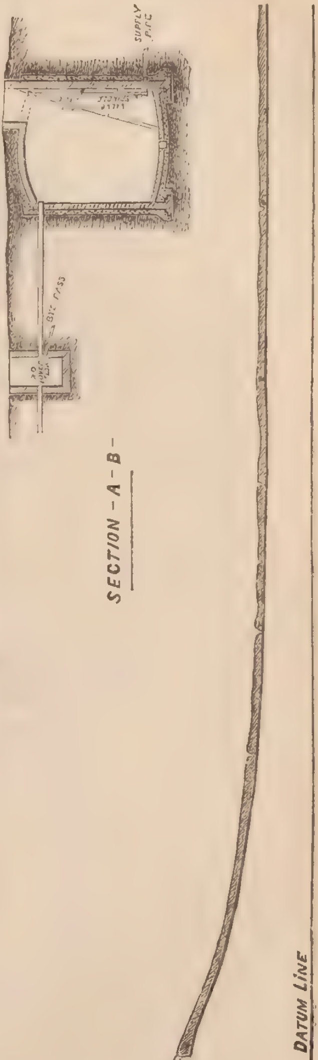
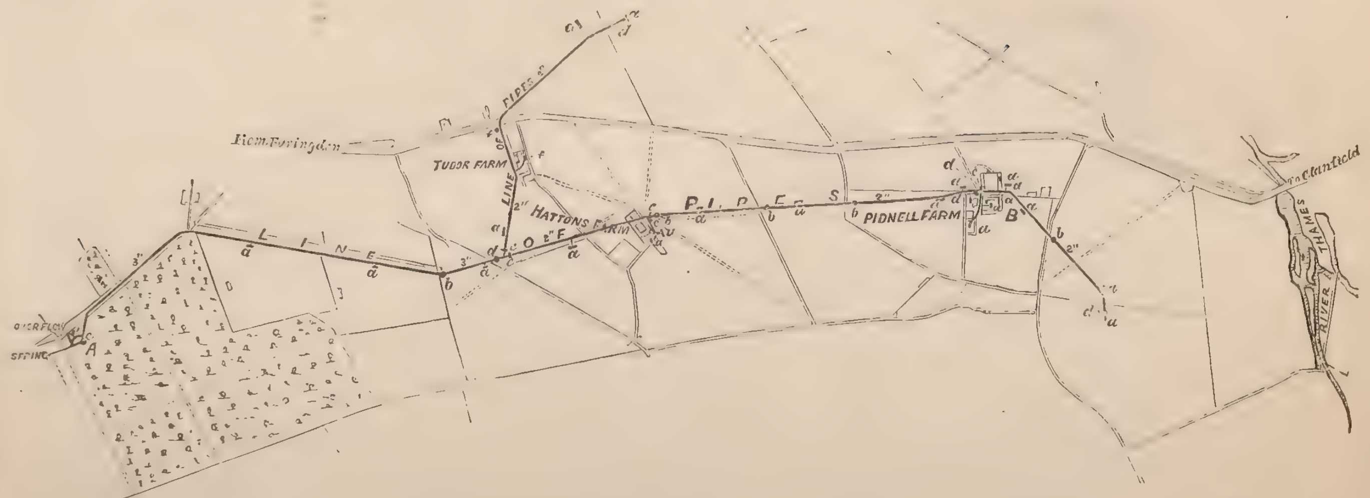


Fig. 1.—*Water supply of Mr. Adams' Farm (Section and cross Section).*

Another work of engineering skill and enterprise, originated by and accomplished under Mr. Adams' direction, is the bringing of a constant supply of pure water to all the homesteads, cottages, yards, and feeding grounds. This is obtained from a spring in the hill-side near Faringdon, and is of excellent quality. The water is first taken into a catch-pit near the source, so arranged that from there it can be conveyed into the service tank constructed to store from six to seven thousand gallons, or round the bye-pass direct to the farms. The overflow pipes empty into an adjoining ditch. From the reservoir the water passes through cast-iron pipes with turned and bored joints to the various troughs and buildings on the farms: air-valves are introduced at suitable distances. All the smaller pipes are of lead, and the whole of the fittings are made with Taylor's patent joints, by which all the connections were united by ordinary workmen,

Fig. 2.—*Water supply of Mr. Adams' Farm (Plan).*



o. a, Troughs. *b. b.* Air-valves. *c, c.* Valves. *d. d.* Hydrants. *e.* Bye Pass. *f.* Tap.

and without the use of solder. The troughs, twenty-two in number, are fitted with ball-valves in an enclosed chamber at the end of each, securely locked, and provision is made in case of severe frost. The main pipes and various branches extend to about three miles in length. So essential is a good and regular supply of pure water to the well-being of stock, and for use where dairying is carried on extensively, that the Judges considered that the designing of these water-works, and the utilisation of the sewage before-mentioned, reflect the greatest credit on the intelligence of Mr. Adams.

The Wickelsome Lodge farm is situated a mile south of Faringdon, the Great Western Railway to that town passing through the middle of it: it belongs to Oriel College, Oxford, was entered upon so recently as Michaelmas of last year, and was then very much out of condition; but a considerable portion being of a sandy and dry nature, Mr. Adams was induced to take it as an advantageous change for his sheep, he having recently lost by fluke on his other and low-lying land, a valuable flock of two hundred Oxfordshire Down ewes.

The College authorities sanctioned the expenditure of a year's rent in repairs, draining, and other necessary work, and very wisely entrusted the carrying out of what was required to Mr. Adams' experience and judgment.

A large number of new gates have been hung and painted, constructed on the principle of being bolted together, so that a rail or brace in case of breakage can be readily substituted. Strong well-framed boarded gates are fixed to the various yards; draining, where required, has been done, including some bogs in the pastures arising from springs, the water from which is conveyed to a suitable place for the use of stock, and the ground filled up with sound material. Useless fences have been removed, all ditches and outlets well cleaned, and a large quantity of lime has been manufactured for use on the land. Altogether, from the time of our first visit in December to the 30th June, a considerable transformation had taken place.

The Lodge farm contains 166 acres of arable and 245 of grass. Coles Pitt field (so called from its neighbourhood to a supposed Roman encampment known by that name) of 34 acres, has 18 down in grass, and the remaining 16 acres are so unsuitable from the nature of the soil for the growth of corn or roots, that the Judges are of opinion it might also be advantageously converted into permanent pasture. Mr. Adams proposes to adopt the four-course system of cropping on the bulk of this arable land, which is well calculated to carry sheep in the winter.

As might be expected with so large an area of grass land,

stock plays an important part in Mr. Adams' management; on the 30th June the numbers were :—

147 Cows in-calf or in-milk.	168 Ewe lambs.
28 Heifers.	1 Two-shear ram.
50 Yearlings.	24 Working horses and a milk horse.
56 Weaning calves.	4 Colts.
4 Bulls.	2 Nags.
335 Breeding ewes.	4 Sows.
11 Shearling show ewes.	9 Store pigs.
20 ditto rams.	1 Boar.
167 Ram lambs.	

The cow stock is of high-class dairy Shorthorn character. Pure-bred bulls from the herds of Col. Sir R. Loyd Lindsay and the late Mr. E. Bowly have been used for many years: all the female calves are weaned, and the bull calves are sold at a week old at two guineas each.

The milk delivered twice a day at Faringdon Station finds a market in London at 8*d.* for the six summer months, and 10½*d.* for the other half of the year, for 17 pints, from which 2*d.* per barn gallon has to be deducted for carriage. The milk is cooled by passing over Lawrence's refrigerators. Occasionally all the milk cannot be disposed of; it is then sent to Hatton's Farm, where Mr. Adams has a most excellent cheese-making plant, and last year 57*l.* worth was produced and sold, 32*l.* was also realised for butter, while the sale of milk amounted to 1674*l.* In the winter the milking cows get three pounds each of cotton-cake, pulped mangolds mixed with straw-chaff in the morning, and an allowance of hay at night. After calving, the cake is increased to four pounds, chaff and mangolds are given as before, and as much hay as the cows care for. They are kept during the winter in yards with a roomy shed in each, and straw is economised by littering only the sheds and a narrow width under the fences. At about the fourth calf the cows are sold off as London dairy beasts.

The management of the bulls is admirable, and too little practised in these modern days. These powerful animals are constantly used for hauling on the farm, geared precisely as horses except the bit. They are yoked in an ordinary farm cart, and do all the carting of fodder, roots, &c., are perfectly docile at work, and much more prolific than when stalled up from month to month.

At Sir R. Loyd Lindsay's sale in May last year, Mr. Adams was the purchaser of two pure-bred roan yearling Shorthorn heifers, from which he hopes to breed bulls for use in his large herd.

Mr. Adams has long been a successful breeder and exhibitor of Oxfordshire Down sheep, and has taken many prizes at the Royal, Bath and West of England, and local Shows. As already mentioned, he had the misfortune to lose in 1880 a fine flock of ewes of this breed; but undaunted by such a reverse, he has, with praiseworthy pluck, set to work to raise another flock, and at the Reading meeting produced two admirable pens of shearling ewes. A ready sale is found for his rams and surplus females in both the home and foreign markets. The ewe flock get in the winter a pint each of malt-dust in the morning, with bean straw at night, besides green food. After lambing, the ewes have hay-chaff, with pulped mangolds; those with twins are allowed extra, half a pound of cotton-cake. The lambs are early taught to feed on linseed-cake, pea-hull, bran and hay-chaff.

The farm horses are of a good stamp for agricultural work, and are for the most part bred on the farm; two journeys go to make up the day's work, and the bait consists of 70 lbs. a week for each horse of rice meal, with straw-chaff, pulped mangolds, and some hay. Mr. Adams thinks highly of this food for horses, and they were evidently sustained by it in good working condition. Except in severe frosts the horses constantly lie out in the pastures.

A sensible institution on the farm is a bell, whose summons may be heard over all the home farms, telling the time for commencing and leaving work.

True Berkshire pigs are cultivated, and, except those fatted for the house, usually go off as stores. In April the swine numbered upwards of 70. Well-bred Dorking fowls and Aylesbury ducks are found in the poultry yards.

Five substantial and conveniently arranged homesteads, all trim and neat, attest the frequent oversight of the master; and the pleasant cottage of the foreman, with its gay and well-stocked garden, are agreeable to look upon.

Near the Pidnell farm we noticed a most objectionable feature in a corn field, in the shape of a row of fourteen trees, about a chain from the hedge, most injurious to the crop, and neither picturesque nor useful.

The Lodge farm had been held by Mr. Adams so short a time that we found it by no means free from couch; neither was that pest absent from the home farms, yet such an evident effort had been made to grapple with the difficulties on the new undertaking, and such an improvement had been effected in cleaning the heavy land on the old occupation, that the Judges felt bound to make every allowance on this score.

The quality of the live stock, with the judicious management

of so large a number as that reared and kept on the farm, were points greatly in Mr. Adams' favour.

The general excellence of the crops and the indomitable energy and skill displayed in the conduct of such a large undertaking and in developing its resources, clearly pointed to Mr. Adams as deserving of high recognition: we therefore unanimously awarded him the Second Prize of 50*l*.

Extra Prize, Class 1.

Mr. Jenkin Davies, Wickcroft Farm, Englefield, Reading.

Richard Benyon, Esq., of Englefield House, is the owner of this farm, which is distant 5½ miles west of Reading, consists of 219 acres of arable, and 104 of grass-land, and extends for two miles by the roadside leading from Newbury to Pangbourne. Part of the land is bounded on the east by "Dead Man's Lane," where Prince Rupert fell upon the retiring army under Essex, the day after the first Battle of Newbury, and inflicted fearful slaughter.

The nature of the soil is light, with a subsoil of gravel.

The tenancy is a yearly one, with the Agricultural Holdings Act barred by the landlord.

Mr. Davies adopts the following system of cropping:—

1. Wheat.
2. Barley, and occasionally part rye.
3. One-fourth rye and three-fourths winter-tares, all used green, with part being cut for horses and cattle, the remainder fed off sheep, then sown with swedes and turnips.
4. Oats and grass-seeds sown.
5. Grass-seeds, first crop cut for hay, and afterwards fed.
6. Grass-seeds, second year, treated as before.
7. Barley.
8. Two-thirds mangolds, including an acre of potatoes; one-third peas; then mustard, folded off; and afterwards dunged for wheat.

When straw is likely to run short, part of No. 2 is sown with rye for a crop, the straw from which can be made available for thatching the other corn.

Oats are sown after roots, as Mr. Davies finds the grass-seeds make barley difficult to harvest, and oats suffer much less from standing longer in the field after being cut. Grass is left down a second year because it is a cheap crop, and the land is improved by the extra folding. Barley is grown for the seventh crop, without grass seeds, and is then readily harvested in ordinary seasons.

Mr. Davies adopts the foregoing system, as he considers a frequent change of crops very desirable on light land: it provides regular work suitable for the seasons; the land is thus never idle; and with a moderate use of cake and corn the condition of the land is improved. He can keep the largest amount of stock without reducing the acreage of corn to less than half the arable land; and he believes it to be the cheapest means of keeping light land in a good state of cultivation.

Wheat known by the name of Doncaster White is the kind grown, and the sample we saw was in excellent condition and of fine quality. This wheat, tested in Scotland, was found to produce six bushels per acre more than several other varieties tried in the same way. Mr. Davies' crops of this grain were regular and healthy: one field of 17 acres was particularly good, although veins of gravel occur in the land, which, in a very dry season, Mr. Davies informed us, affect the yield to the extent of one-half. Part of this land lies low, and had suffered from water standing on it, until Mr. Davies, at an expense of over 30*l.*, cut an open ditch right through the field to a depth, near the outlet, of 5 feet: towards this the landlord allowed 10*l.*

We were sorry to observe in this, as in some other arable fields, trees standing out in the open, shading the land and making it more difficult to plough and work. Round a field of wheat containing 1¾ acres, we counted no less than 35 trees, mostly of considerable dimensions, growing in the outside fences.

One part of Mr. Davies' farm consists of a number of very small enclosures, some being detached; in one or two there are to be found pits with a growth of underwood and willows which might with great advantage be filled up and thrown into the field; and if much of the hedgerow-timber were cut and some of the fences abolished, encouragement would be given to a good tenant, and the estate be benefited.

Webb's Kinver barley appears to be the favourite sort with Mr. Davies, and the crops of it were good for this kind of land, which produces samples of malting quality.

Oats were an excellent crop, part being Waterloo; the others had very much the appearance of the winter variety, although they had been sown in the spring.

Early dun and grey Warwick peas are planted: were a full crop, and forward, but had partially suffered from an attack of green fly.

Beans are in some instances drilled with the vetches for sheep feed, the proportion being 5 pecks of the former to 6 of the latter. This crop we also saw grown on other farms, and were told that sheep are partial to it.

The grass seeds are a mixture of ½ a bushel of Italian rye-

grass, 8 lbs. of cow-clover, and 4lbs. each of giant Dutch and alsike per acre.

The land for mangolds is well ploughed in the autumn, scarified and cleaned in the spring, receives a heavy manuring of farmyard dung, and 2 cwt. each of Proctor and Ryland's superphosphate and salt sowed broadcast. The seed is Sutton's yellow-fleshed, and Webb's intermediate, drilled in rows 2 feet apart.

As swedes and white turnips are taken after the fold, they get the artificial only, as above. Carter's prize, and Sutton's Champion swedes are the kinds grown, with 3lbs. of seed per acre. The root-crops are regular and healthy, and quite clean.

The farm is this year cropped as follows:—26 acres wheat, 60½ barley, 28½ oats, 8 peas, 10 rye, 19½ mangold, 10 swedes, 5 turnips, 27 grass first year, 26 grass second year, 43 acres meadow mown for hay, and 60 grazed.

Nearly the whole of the live-stock is bred on the farm, a few calves being bought for weaning. The cattle are neat useful Shorthorns, and the milk is disposed of by dairying and calf-weaning. The flock is a cross-bred one, and the pigs really good Berkshires. The farm-horses are well kept, clean-limbed, serviceable animals, and very active. Poultry is reared in considerable numbers, and made to contribute towards the household expenses. On the 22nd April the live-stock stood thus:—

12	Fatting Beasts.	126	Ewes.
8	Milking Cows.	158	Lambs.
4	In-Calf Heifers.	3	Rams.
10	Two-year-old.	6	Sows and 1 Boar.
22	Yearlings.	28	Pigs.
23	Weaning Calves.	9	Working-horses.
2	Bulls.	1	Breeding-mare.
154	Fatting Sheep.	5	Colts and 1 Nag.

Cattle, sheep, and pigs are all fed for the butcher before leaving the farm, and in this way the average sale of stock for the past three years has realised one thousand and forty pounds, and the amount of stock bought in each year has been one hundred and twenty pounds.

Labour on the farm is done at a cheap rate, costing 28*s.* an acre. This, in a great measure, may be attributed to the active part taken in the work by Mr. Davies and his sons.

The wages of ordinary labourers are 12*s.* a week; carters and stockmen get from 13*s.* to 14*s.*, with a cottage rent free, and 3*l.* extra for the harvest, with beer, or its equivalent in money, at the rate of 6*d.* a day.

Two hundred and ninety pounds was the expenditure last year for cake and corn consumed, and 36*l.* for artificial manures.

Mr. Davies has during his tenancy taken up 137 chains of useless fences at a cost of 55*l.*, and has chalked the land at his own expense.

The farm-buildings are conveniently disposed near the house, and two large corn-sheds have been recently added by the landlord. The premises are good and suitable for the occupation, but the stable, in the opinion of the Judges, required more light.

A capital assortment of implements, all in good repair (including reapers, mowers, and threshing tackle, which are let out for hire), and when not in use are carefully housed, and a valuable lot of machinery for preparing food for the stock is fixed on a large upper floor, and can all be driven by a portable engine from an adjoining shed. Threshing and chaff-cutting are also carried on at the same time.

The whole of the arrangement has been ingeniously devised by Mr. Davies, assisted by his son, who drives the engine, and has evidently a bent for mechanics.

The bulk of the land on this farm is by no means of high natural fertility, probably less so than that on most of the competing farms, yet the management is so good, and the results obtained by persevering industry are so satisfactory, that the Judges had pleasure in recommending that an extra prize of 25*l.* be given in this class to Mr. Davies.

In Class 2 only one entry was made, and this the Judges considered was devoid of all the qualifications expected in a prize-farm, and its introduction was ill-advised.

The farm accounts kept by the competitors, we found unsatisfactory as a reliable guide in estimating the results obtained, owing to the absence of yearly valuations and balance-sheets.

In some instances, really sound practical farmers had for the first time attempted book-keeping, in connection with this competition, and by this time have probably abandoned it as a hopeless task.

The duties connected with farm-judging are onerous, and entail a large amount of anxiety and physical labour; at the same time much valuable information is obtained, and pleasant associations are formed.

In the discharge of our task we have gratefully to acknowledge the hospitality extended to us on all occasions, and the information most willingly imparted, and it was a source of much satisfaction to ourselves that unanimity prevailed in all our decisions.

James Long.
William Parsons.
John H. Blundell.

XXXI.—*Report of the Senior Steward of Live Stock at Reading.* By Charles Howard, of Biddenham, Bedford.

The Royal Agricultural Meeting has once more come and gone, and I, like many of my predecessors, have to give "an account of my stewardship" in the form of a summary of its proceedings, leaving a more detailed account of the exhibition of Live Stock to the official reporter. On this occasion these duties have been carried out by the Rev. G. Gilbert, a well-known contributor to our agricultural literature.

When the district was first announced in which the Show was to be held, public opinion pointed to the Royal County, and to its chief town, Reading, as the most suitable place. The Council ultimately and wisely confirmed this choice. At no previous meeting has the Society had a more cordial and enthusiastic reception than was given to it by the good people of Reading. The town and suburbs, although pleasing and picturesque in themselves, were decorated to an extent hitherto unknown, at a cost, it was said, approaching to 1000*l.*

The visit of his Royal Highness the Prince of Wales caused the greatest enthusiasm, and a right cordial reception was accorded him by the inhabitants of this loyal borough and neighbourhood.

The Local Committee did all in its power to make the Show a success, while the Mayor and Corporation were profuse in their hospitalities to the President, Council, and Officers of the Society in the magnificent hall which the town has lately erected.

The enterprising firms, of world-wide fame, Messrs. Huntly & Palmer, and Messrs. Sutton & Sons, contributed very greatly to the gratification of numbers of visitors, by throwing open their establishments to their inspection.

The Show-ground contained some 70 acres, and was one of the best the Society has ever had placed at its disposal. The subsoil being of a gravelly porous character, was, under the circumstances as to weather, highly suitable. It was situated outside the borough boundary and within ten minutes' drive of the railway stations at Reading. It was easy of access, having good roads, a tramway running within a short distance; and, thanks to the efficiency of the police arrangements with regard to the traffic, no inconvenience was experienced.

The planning of the Yard, together with the erection of the shedding and requisite offices, was in the hands of the Society's Superintendent of Works (Mr. Bennison), and every one was struck with the admirable manner in which all the arrangements were carried out; nothing appeared to be left

undone which could be desired. The preparations for the Show were as complete as man could make them, but its success was marred by influences beyond human control. There appears to be a fatality about the Royal Show as regards the weather; during three out of the four years I have had the honour of being Steward, rain has been ruinous to the Show. Many were the suggestions as to holding it at a different date, it being contended that July is generally a wet month. Until the last few years wet weather has been the exception, and one can well remember the brilliant sunshine which has favoured so many Royal Shows. No better time could be selected for holding the Meeting, as it generally occurs, in the average of seasons, at a leisure time, viz. between hay and corn harvest. The Council will no doubt pause before making any alteration.

Showers fell heavily on Monday afternoon, but there was a thorough downpour on Tuesday during nearly the whole of the day, not only injuring the Show, but doing a great amount of damage to the crops throughout the country, inflicting another loss upon a body of men who are little able to bear it.

On Wednesday His Royal Highness the Prince of Wales visited the Show, and brought with him truly "Royal weather," the day being all that could be desired. The numbers exceeded by nearly three times those of the preceding days, the Show-yard presenting a most charming appearance. Showers again fell on Thursday and Friday, but not to the extent to cause any great inconvenience. The weather, of course, greatly affected the attendance, the numbers being fewer than at any meeting since Taunton. The result will be attended by another drain upon the "Royal" exchequer, increased by the heavy expenses in trying the novel experiment of making hay in wet weather. For this attempt, the weather, damaging as it was in other respects, was all that could be desired, the practical farmers finding, upon a visit to the trial-fields, that the results promised in glowing advertisements could not be realised, the operations all being at a stand-still.

The weak feature of the Show was that of the exhibition of Horses. With the exception of a few well-known entire animals, it did not reach the standard of many local shows. To remedy this state of things is a matter for the serious consideration of the Council.

The show of Cattle was one of the best ever seen in a Royal Show-yard; the most remarkable for excellence being the Shorthorns, Herefords, and Channel Islands breeds.

The parade in the large ring of all the prize animals for the inspection of his Royal Highness the Prince of Wales was a grand sight, and one of which this country has great reason to

be proud: it is not too much to say that nothing approaching it could be seen in the wide world.

There was a large show of Sheep, and the Steward of that department (Mr. Turner) speaks in the highest terms of their general excellence; the number of entries being 28 more than at Derby. The chief attractions were the Shropshires, Oxfordshires, and Southdowns. There were, we are glad to report, only two disqualifications for improper shearing—a result confirming the wisdom of the Council in continuing the inspection. The Steward of the Sheep complains of the manner in which some breeds are oiled, greased, and coloured, to the discomfort of those who desire "to keep clean hands."

There was a large and excellent show of Pigs, many animals being of surpassing merit. I regret, however, to add that our eminent Veterinary Professors had several disqualifications to make as to age, while other practices were resorted to, which, to say the least, do not add to the respectability of the pig exhibitors. It was suggested by some that the Council should institute a rigorous inquiry in a few of the worst cases, at the homesteads of the exhibitors, and a report published; by others, that the Council would do well to discontinue its show of pigs until a higher tone of morality obtained among pig exhibitors, their bailiffs, or herdsmen. Leniency in the past has failed; it is therefore high time for the Council to take strong measures to stamp out such disreputable practices, or the honest exhibitor will retire from a contest in which he feels so unequally matched.

The General Meeting of Members took place in the large marquee on the Tuesday. There was a very large attendance, accelerated, no doubt, by the downpour of rain which took place at the time appointed for the meeting, many gladly taking shelter. As at most public meetings in England, there were some grievances to be aired. The horse department of the Show was referred to, and suggestions were made for its improvement at future meetings. The amount of the sheep prizes, the position of Hereford cattle in the yard, together with the constitution of the Council, were all commented upon; to all of which the President ably replied, promising that the suggestions should receive the best attention of the Council. The President-elect, his Grace the Duke of Richmond and Gordon, being introduced, had a most cordial and hearty reception, while the thanks of the members were warmly given to the President on his retirement from the office which he had filled with so much honour to himself and with such great service to the Society. Thus ended most satisfactorily the General Meeting of 1882.

There were numerous complaints about the supply of refresh-

ments, many expressing regret at the discontinuance of the members' refreshment tent. This is a matter which will also have to come under the consideration of the Council. The members should know that there are many things the Council would gladly carry out if their exchequer would permit. For a national Society the number of members is insignificant, and it behoves all those who desire to see the Society advance, to induce their friends in their respective localities to place their names on the members' list.

One of the most interesting proceedings of the week was that of the service in the large marquee on the Sunday morning. The attendance was very numerous, some 800 or more being present. The congregation was unique; many were the parishes in almost every nook and corner of England which were represented in that assembly; the Channel Islands, Scotland, and Ireland also contributing their members. The Bishop of Oxford was the preacher, and well will it be for all those who heard his practical, stirring, and faithful appeal, if they will practice in their every-day life what they then heard.

For the complete arrangements of the Show the best thanks of the Society are due to its able Secretary and to the "General" Steward, Mr. Jacob Wilson, whose great ability and fitness for the office are acknowledged on all hands. The Stewards' work was made comparatively easy by the untiring exertions of the Assistant Stewards, Messrs. Tindall, Reynard, and Beck, jun.; I think it due to those gentlemen to acknowledge their services, not only on behalf of the Stewards, but of the Society.

Nothing more is now left for me than to thank my brother stewards and all the officers of the Society, from the highest to the lowest, for the great kindness and assistance I have at all times received at their hands. I shall ever look back with the most lively satisfaction to the pleasant associations of my four years' term of office.

XXXII.—*Report of the Live-Stock exhibited at the Society's Meeting*, 1882. By the Rev. GEORGE GILBERT, of Claxton, Norfolk.

AT least three independent agencies—weather, population of district, and the great public of breeders—must all prove propitious before any one of the Society's Annual Meetings can be said to have been really successful. Once a year, therefore, the Society has to risk no small part of its reserve forces—*i.e.* its funded capital and its reputation—to the keeping of allies over

whom it can exercise but imperfect control. At Reading the first-named of these inevitable associates was distinctly treacherous; and the second a somewhat inadequate assistant. But the third came forward with such generous and efficient support, that the Society's honour is a gainer by the Exhibition, whatever may be the result to the treasury.

There have been, no doubt, previous occasions upon which some one variety of live-stock has been more splendidly illustrated than at Reading. There have been, in sheep and cattle, individual specimens which stood out with greater distinctness among their fellows than any which can be named in 1882. Still, after having seen the majority of the Society's Shows since that held in Northampton in 1848, one may say that so comprehensive a display of the various breeds of farm stock cultivated in England has never been seen before; nor yet a collection in which the average standard of merit in each class was so uniformly high. No variety peculiar to Wales was to be seen. The Galloway cattle and Herdwick sheep of the Lake district were unrepresented. Indeed, the whole of the black breeds of cattle were, except for a couple of little Kerry cows, "conspicuously absent." And so, too, were the horned Dorset sheep and the peculiar breed of Downs which is now called Suffolk. And, although it might be possible to call to mind other local sub-varieties of sheep, as Lonks, Wensleydales, and Cheviots, which did not put in an appearance, it will still remain true that the live-stock of this country were extraordinarily well shown at Reading, both as to numbers and as to quality. The weakest point of the Show was the section which opens the Catalogue. Partly from the classification into which the Society has drifted; but still more by reason that a preparation for the Society's Meetings would clash with the busiest part of the breeding season, entires and mares (cart-horses) are not shown to anything like the extent which is desirable. But perhaps it is the function of a reporter to enumerate rather than to criticise; to say what was present, rather than to find reasons why anything was not.

Yet, even so, some preliminary remarks seem necessary. The arrangement, recently adopted by the Society, of including in a class all the produce of some one year, acts beneficially for horses and sheep (which have one common and limited season for breeding); but it, certainly, is not so well suited for cattle in the younger stages of growth, because cattle breed all the twelve months through; nor yet is it fitting for swine, whose litters are not desirable in the very depth of winter. A reconsideration, in some instances, seems expedient if the general convenience be worth taking into account. "Calved in 1882, but

above twelve months old on the day of showing," and "calved in 1882, but less than twelve months old," would form a more appropriate division next year; even if the funds of the Society should allow only one prize to be given to each section. It is impossible—and therefore a task not fair to impose on any Judge—to balance between the promise of a calf still largely dependent for merit on the milking of its nurse, and the performance of a yearling which is able to take up, and to prove its power of assimilating, the ordinary food upon which cattle are fed and fattened, whilst "farrowed in 1883" will give too wide a margin for that infirmity of recollection which seems peculiar to pig breeders. No section of the Society's clients make such demands upon the public to take abnormal growth upon trust. "Best litters still sucking upon the dam," would form a safer limit than any mere statement of "farrowed in 1883." The mother sow would have some remarks to make upon the subject of abnormally advanced dentition, which would be to the full as pertinent as any conclusions which are now courageously arrived at by the Society's Veterinary Inspectors.

And it certainly does seem a little inconsistent, when the Society has issued a strict rule against the employment of lamp-black and white paint in giving a finishing touch to pigs, to find the owners of sheep permitted to be so dependent upon red ochre and sulphur for giving the specimens of their flocks "the last dip" before allowing the public to see them. The Society's object is to show people what is the best stamp of animal to breed from; proceeding upon the recognised principle that "like begets like." But, in the matter of sheep-breeding, it seems accepted that animals are to be shown such as cannot possibly reproduce anything like themselves. Will the tup, with the ruddled, felted fleece, beget lambs one whit nearer the type which he wears at the Show, than will the rough-looking, because naturally shown, sire? or will the ewes, loaded with as much colouring-matter as their wool will hold, breed lambs at all resembling them in the gorgeous hues which they display? These exhibitions exist for those who have yet to learn, as well as for those who have burnt their fingers by experience. The present fashions of exhibiting sheep are perilously akin to that of oversizing calico with fuller's-earth, which has undermined more than one branch of our foreign trade; and they have close connection with the tricks of the horse-coper. No doubt there are markets in which sheep appear equally bedaubed; just as there are markets in which cows stand with the ring scraped from their horns, and horses gingered into a spurious display of spirit. Yet all such practices are, alike, mere dealers' tricks; unworthy of imitation from men whose aim should be

to show that agriculture and the production of fine herds and flocks is one of the most ennobling, as it is one of the oldest, occupations in the world.

HORSES.

From the very peculiar method in which the Society's Catalogue arrives at its definition of what constitutes the English breed of heavy draught-horses, it seems necessary to discuss first the display of Suffolks. An English carthorse, it would seem, is anything "which is not Suffolk nor Clydesdale." We must enquire then what were, at Reading, the Suffolks or the Clydesdales? And having got these out of the way, one may arrive at an opinion of what Mr. Bright calls "the residuum," which in this case is the English carthorse.

SUFFOLKS.

The Suffolk horses at this year's exhibition would have attracted the notice of the most careless observer. They formed six classes of magnificent chestnut horses; of which the most remarkable points were, 1st, that they should ever have been bred to cultivate a stubborn clay; 2nd, that they were not Oriental; so like a Barb are many of them, especially among the mares. The Judges, with natural enthusiasm, pick upon the most suspicious points of their favourites for praise; and especially approve "their feet;" and say that *now* "these will stand the London stones." "The London stones," now-a-days, when it does not mean asphalte, means wooden-pavement; and the noble, clean-legged, spirited animals at Reading might certainly suit both. Indeed, they seemed far more adapted to "bowl along" a brougham or waggonette in Regent Street than to tug a tumbril or timber-wain in a Suffolk lane. Yet it cannot be questioned that the Suffolk will drudge on a farm, for Suffolk evidence, to this effect, cannot be gainsaid. Mr. S. Wolton's "Newbourn Princess" is a kind of "Pocahontas" or "Queen Mary" in her way, having bred both "Chieftain" (1st in Class 7) and "Chief-of-the-East" (1st in Class 8). The Duke of Hamilton's "Chief" (1st in Class 9), owed, it was said, his position to a third Judge, who was called in as referee. At the County Show, Mr. Horace Wolton's "Multum-in-parvo" was, as here, second. But his conqueror, at Framlingham, was Mr. R. H. Wrinch's "The Wanderer," now put third; whilst at Reading, as has been said, the "Chief" won. These two judgments should put Mr. H. Wolton's horse as about the best of his year. There were few mares. Only one appeared with

foal at foot; and two (including the champion "Belle of the Ball,") were shown in a class for pair of work-horses. But the Suffolk fillies quite sustained the character of the year as being one favourable to the sex. Both Classes 23 and 24 showed to great advantage in the ring; and, perhaps, in virtue of having had three out of four daughters noticed by the Judges, Sir Richard Wallace's "Prince Imperial" took the lead among the sires, as a getter of good fillies; and is quite the "Hermit" of the breed.

Judges' Report on Suffolk Horses.

Our task of going through the Suffolks being completed, we can but observe what excellent specimens have been brought before us; and we must congratulate the Suffolk breeders that their animals generally have not only full size, but are very active; and, with the exception of two or three, their feet are remarkably good. If they will but go on in that direction the Suffolks will stand the London stones as well as any horse, and make a most valuable breed, for their hardihood is undeniable.

For young *Stallions*, we look upon Class 8 as consisting of some most promising colts. They are generally good; and no doubt many of them will be seen again in the Showyard.

Class 9 was a good lot; and as our judgment was not altogether in unison, a referee's opinion had to be obtained, who soon selected activity for more substance.

The *Fillies* were a splendid lot. In Class 23, No. 138, a beautiful specimen, lost her higher honours by perhaps a little weakness in the hocks.

Class 24 was a splendid lot; and the entries gave the greatest difficulty to discriminate between their respective merits.

In Class 25, although they did not come under our judging, were two rare specimens of the Suffolk breed; and it is much to be regretted they were not met in competition by the Shire-bred, or Clydesdale Mare or Gelding, but had to carry off the prize unopposed.

EDWARD G. HODGSON.
DANIEL SEWELL.

CLYDESDALES.

Clydesdales—although so far from home, and although, as the Judges apologetically state, "no Scotch exhibitors are represented"—well maintained their claim to distinction. There were few, if any, two-year-olds to beat Mr. G. Rodger's chestnut "Warlock." This, bred by the exhibitor, was put the champion of all the Clydesdale entires. The Judges, in their Report, give this colt a testimonial. But they do not (as ought to be mentioned), point out that both the prize-winners in Class 5, and the best winner among the fillies in the good Class 22, came from the stud, once collected at Dunmore by the same indefatigable patron who, by endowing the breed with one of the very best of Stud Books, opened for it improved markets all over the world. There is not the smallest doubt now as to the efficiency of a good herd- or stud-book. It doubles the demand from what may be called amateur, as distinct from professional, buyers;

and there is little doubt as to which class bids the most generously. "Victor Chief" (1st in Class 5) was a short-legged, compact, nice horse. It is worth noticing that, in addition to Westmoreland and Durham, into which, with other northern counties, the Clydesdale has long penetrated, Surrey, Sussex, Devonshire, Berkshire, and Northamptonshire all have breeders of this hardy active variety. It is certainly no disparagement to the English carthorse to say it is "something not Clydesdale;" but what would the Clydesdale itself be—including all the descendants of Drew's "Prince of Wales"—if the English elements in its composition were to be subtracted from it?

Judges' Report on Clydesdales.

Class 4.—Small class in regard to numbers, and nothing special to mention in regard to quality.

Class 5.—Only two shown, and of fair quality.

Class 6.—Small class, but first and second good serviceable animals, and likely to improve the breed.

Class 14.—Large class, and some fair representatives of the breed. First, second, and third, very good mares.

Class 21.—Small in numbers, but first and second very good mares.

Class 22.—Very good class. First, a very sweet little filly; second, large growing filly likely to improve; third, a fair filly.

Champion Prize for Clydesdale Stallion.

No 41.—Two-year-old, a large good-boned colt, and likely to grow into a first-rate horse.

And we may say that it was a good show of the breed when we consider that no Scotch exhibitors were represented.

Robert Findlay.
Thomas Kerr.

When one gets to the English horse—his negative rivals being out of the way—it seems hard to find that he hasn't a name. Yet no description, short of that in the Book of Job, would do justice to Mr. T. Shaw's "Cromwell," champion among all the carthorses, "not Suffolk nor Clydesdale:" and it might have been said "among all the stallions in the Show," except "Fashion," No. 74. These two include, between them, every merit a horse can have for the road. "Cromwell" has strength, weight to throw into collar, spirit, and activity; "Fashion," neatness, action, grace, and speed. It does not matter very much by what name English horses are called, so long as the country can breed a "Cromwell" and a "Fashion." "Cromwell" is described, at Reading, as "best Carthorse not qualified to compete as Suffolk or Clydesdale;" and "Fashion," when last encountered, had over his stall a card of "best sire for begetting high-

stepping cobs." And each was a specimen of its type which can hardly have been ever excelled.

"Cromwell's" principal opponent was Mr. W. Gilbey's well-known "Spark," who, in the presence of his conqueror's dash and fire, seemed lumpish and dull. Yet "Spark" is a superb specimen of the heavy carthorse. The Earl of Ellesmere's four rather lacked substance, as compared with the two before-mentioned. But there is as much use for a small-sized, as for a larger-sized, draught horse. And no one can say "Silent James" or "Eclipse" want anything except size. They are as neat and active as can be desired.

The Hon. E. K. Coke came next prominently forward. His "Conjuror" is a tough active horse, with short hind-quarters. His "Certainty" is a far more attractive, though probably not more useful colt, even if it be sound, of which there seems some question, for it was passed by at Islington. Whilst his "Chance" (a black filly of '80) is a short-legged stirring animal, likely to breed good things. Her companion, "Carouse," looks half a Suffolk. Mr. T. H. Miller's two excellent mares, by Welcher's "Honest Tom," were again prize-winners; being divided by the Duke of Westminster's chestnut roan, by "What's Wanted." These two sires take the lead with active bustling sons and daughters; as "England's Wonder" and "William the Conqueror" do with a heavier type. Mr. Miller's "Mascotte" and "Magpie" are by "Lincoln," and are very stylish fillies. Mr. W. Gilbey, whose stud represents, at present, spirited purchase rather than successful breeding, has in "Magdalen Beauty" a first-class mare. Her colt-foal by "Spark" should prove something very uncommon; whilst "Chocolate" (the Hon. E. Coke's first-prize two-year-old at Derby) promises, with age, to become one of the most useful mares in England. H.R.H. the Prince of Wales, in "Jewel," has a capital mover, very well suited to Norfolk soil. It would seem that the only classification of carthorses which can long remain satisfactory is one of measurement. There should be classes for carthorses under, and others for those above, a fixed standard. It is impossible to rest on distinctions in blood. Norfolk and Lancashire, Welshpool and Derby, and all that lie between these four points of the compass, are all employing, in different years, the same stallions. Whilst a Shire-bred with a Clydesdale cross, and a Clydesdale who numbers amongst its ancestry "mare bought in England," can hardly be asserted to be independent breeds.

Judges' Report on Agricultural Horses.

In submitting our Report of the Agricultural Horses at the Meeting of the Royal Agricultural Society at Reading in 1882, we are sorry we cannot

state that those classes were well represented; neither were many of the classes of great excellence, yet, in some, we found animals of great merit, and pure types of the English carthorse.

Class 1. *Agricultural Stallions foaled in* 1875, 1876, 1877, 1878.—No. 7, a brown horse, was placed first. This is an uncommonly good animal, with fine action; No. 6 coming second. This is a heavy, useful black horse, of great substance, but wanting the action of the first-prize horse. No. 2 was placed third, and No. 1 reserve number.

Class 2. *Agricultural Stallions foaled in* 1879.—No. 12, a bay colt, was easily selected for the first prize; he will some day be seen elsewhere to the front. No. 10 came second. This is a strong useful colt. No. 13 was placed third, and No. 15 highly commended and reserve number.

Class 3. *Agricultural Stallions foaled in* 1880.—No. 24, a very useful chestnut colt, with good action, came first; and, for the second and third prizes, two brown colts, Nos. 27 and 26. No. 30 was highly commended and reserve number, and No. 20 commended. This Class was well filled, no less than 15 being present.

Class 13. *Agricultural Mare and Foal.*—This prize was without difficulty awarded to No. 79, a good bay mare and foal. This is a wide thick mare with good action. No. 87, a roan mare, came second. No. 80 was third, with No. 82 as reserve number.

Class 19. *Agricultural Filly foaled in* 1879.—Here our task was easy: the first prize falling to No. 116, a very good brown mare with fine action, flat-boned legs and good feet, the very stamp for a good brood mare. No. 112 came second. This is a heavy black mare with splendid action, good legs and feet, but wanting the substance of the brown mare. No. 113, a bay mare, came third; with No. 114 highly commended and reserve number.

Class 20. *Agricultural Filly foaled in* 1880.—We soon selected No. 121 for the first place. This is a good black filly, with plenty of substance and a fine mover. No. 118, another black, coming second; with No. 119, a chestnut, third; and No. 122 reserve number.

Class 25. *Pair of Agricultural Horses (Mares or Geldings) foaled previous to the year* 1878.—We were sorry to see only one entry in this Class, to which we awarded the first prize, it being considered of sufficient merit.

Class 26. *Mare or Gelding foaled in the year* 1878.—Here we had only one entry. We awarded the first prize; though it was doubtful whether there was sufficient merit.

Class 27. *Agricultural Gelding foaled in the year* 1879.—We had no difficulty in awarding the first prize to No. 154, a very good bay colt. This horse has great powers, with good legs and feet and fine action. No. 153 came second—only two being present out of three entries.

Class 28. *Agricultural Geldings foaled in* 1880.—Only three entries in this Class. We awarded the first prize to No. 156; the second to No. 157; making No. 158 the reserve number and highly commended. Under a special note in the rules of the Society, the third prize in this Class was withheld, unless six entries were exhibited. Only three entries coming into the ring, no third prize was awarded.

Champion Prize for Agricultural Stallions.—This valuable prize fell to No. 7, the brown horse that won in Class 1.

We cannot conclude this Report without expressing our thanks to the Steward of this Division for the very careful arrangements he had made, and for the excellent manner in which they were carried out; no time being lost in getting the various classes into the ring.

Samuel Rowlandson.
Thos. Plowright.

Hunters.

Of the Hunters, and Stallions for begetting these, it is best to speak with the reserve which befits inexperience. When the Judges' report, "a very moderate lot, and calculated to do more harm than good," it is somewhat difficult to announce "a success." Indeed, not only what Mr. Hutchinson has written, but the universal expression of spoken opinion in the Showyard, combined to determine that circumstances are stronger even than the prestige of a Royal Show; and that these have brought about a crisis, in the connection between the Society and breeders of hunting stock, which requires this portion of the prize-list to be entirely revised and reconstructed; or else to be excised altogether. It is hardly possible and quite unnecessary to add anything to Mr. T. H. Hutchinson's remarks. It will be observed that, in this department, the Judges have given in separate reports. Not that there is much discrepancy of opinion as to what existed: and both agree that Class 30 (i.e. that for light-weight Hunters) had considerable merit. But it is noteworthy that all three of the prize-takers are entered as "breeder unknown." This does not occur in a district where breeding hunters is on a sound footing.

Judges' Reports on Hunters.

Class 10. The *Thorough-bred Stallions* are a very moderate lot; and, with the exception of the first and second-prize horses, are calculated to do more harm than good wherever they are used. The first-prize is a long low horse, full of quality, with good knee and hock action, but has too long pasterns, and is rather light over his back. The second prize has a fine top, but is too long on the leg, with straight pasterns, and wanting in bone. We consider giving a prize for stallions at this time of the year a mistake; as no Agricultural Society can afford to give a prize of sufficient value to induce owners of valuable sires to risk them in a Showyard for a week. Besides the risks, any really good horse, who has made a good season, is hardly fit to show early in July. I think it a pity that the Royal Agricultural Society's stamp should be put on inferior stallions. Unless some means can be found to bring higher-class sires to their Show, it would be better to abandon the prize altogether.

As to the Hunters brought before us, I am sorry to have to report that, with a few exceptions, they are a most wretched lot; not equal to what are shown at many small Provincial Shows; and they certainly are not the class of horse any one would expect to find at our Royal Show. This is very much to be regretted; as many foreigners visit the Showyard, and cannot fail to be very much disappointed with the miserable specimens of hunters they find there. We think the fact that exhibitors of hunters will not bring good horses to the Royal may be accounted for by the smallness of the prizes offered, the length of time they are kept at the Show, and the heaviness of the incidental expenses incurred. As horses are always one of the greatest attractions at an Agricultural Show, surely it is worth the while of the Royal Society to make some effort to bring together a class of horse which will keep up our prestige as a horse-breeding country, and do credit to our great National Show.

Class 16.—First and second prize *Mares*, if put to good sires, look like breeding good hunters; the others are a very moderate lot.

Class 16.—A wretched class, the prize-horses are hardly up to 15 stones. We were obliged to award the prizes to them, as the stronger-looking horses could hardly carry themselves.

Class 30.—Much the best class we had before us. The winner, a really nice short-legged, blood-like 12-stone hunter; the second, a horse full of quality, but with rather too high action for a hunter. There were four or five other nice horses in this Class.

Class 31.—Only two appeared in the ring, one lame, the other a very moderate animal.

Class 32.—First, second, and third-prize horses were strong horses, and might get to hounds if their owners did not want to go too fast.

Class 33.—The prize-takers were nice fillies.

Class 34.—The winner full of quality; the other two were commoners.

T. H. Hutchinson.

Class 10. *Thorough-bred Stallions for getting Hunters.*—A very moderate class; the winner, "King of the Forest," was a light elegant horse with rather weak pasterns, a nice mover in all his paces, but he has not sufficient power and bone to be likely to get hunters up to much weight. The second-prize horse, "Philammon," had more power, but his upright joints and leggy appearance were against him as a hunter-sire. The others exhibited were very moderate.

As the object of the Society is to encourage the exhibition of really useful hunter sires of pure blood, it behoves the Council to make some alteration in the conditions; and, if I might suggest, more substantial money prizes should be offered; and it should be a *sine quâ non* that horses exhibited should cover at a fee within the reach of tenant-farmers. The owners of sires which have a good reputation do not care to incur the expense of sending their horses a long distance, with the risk of a week's sojourn in the Showyard, unless the prizes to be won are more substantial.

Hunter Brood-Mares and Foals were also a very moderate class; the prize-winners both being below the calibre of many local Show exhibits. This we must attribute to the fact of the Show being held in a district where hunter-breeding is not much pursued; and that owners of valuable mares and foals will not incur the risk and expense of sending them a long distance to contend for a 20*l.* prize.

Class 29—*Hunter (Mare or Gelding) up to* 15 *stone, Five years old and upwards*—was another very moderate class. The first prize was awarded to a horse that moved well in all his paces, yet he was not really more than a 13-stone hunter; but, as the whole class was greatly deficient in weight-carrying power, his quality was served. Evidently the numerous Hunter Shows, held earlier in the summer, are prejudicial to the Royal.

Class 30—*Hunter (Mare or Gelding) up to* 12 *stone, Five years old and upwards*—was a very fair class. The winner, a nice useful compact horse and a good mover, thoroughly deserved his award. There were several good light-weight hunters in this class, and it may be considered a good class.

Class 31. *Hunter Mare foaled in* 1878.—A very moderate class, and only three exhibited, the winner being the best of a bad lot.

Class 32. *Hunter Gelding foaled in* 1878.—The prize-winner looked like growing into a good horse. This could only be called a fair class.

Class 33. *Hunter Mare foaled in* 1878.—Only three showed in this class, and require no comment.

Class 34. *Hunter Gelding foaled in* 1879.—Only three exhibits. The first-prize horse was full of quality, and looked like making a nice light-weight hunter.

C. Rivers Bulkeley.

Hackneys.

It will be observed that the Judges of Hackneys are far less open-mouthed in their condemnation of the present state of things. They both admit that it was impossible, in the presence of Mr. Grout's "Fashion," No. 74, and of Mr. Griggs's "Model 2nd," No. 70, to say hard words of the sires for breeding horses of this character. "Fashion" "brought down the house" whenever his groom "let him out" in the ring; and "Model" only failed to do as much because "Fashion" was present. The action of the chestnut would have been deemed good had not the brown captivated every one's fancy. It is curious that the hackney or even hunting mares with their foals do not form so pretty a sight as do the corresponding classes among cart-breeds. The foals of the latter do not betray timidity. They canter and skip, and gaze about with an odd rustic *naïveté* which is singularly attractive. Mr. P. G. Hamerton says: "all artists delight *first* in heavy-horses." He might add, "carthorses, in a natural condition, at all stages of growth, have a distinct first place in the interests of every English crowd which knows what the work of the world is and who does it." It is again deserving of note that both of the Duke of Hamilton's light-brood mares and Mr. T. H. Miller's (i.e. the leading prize-winners) are all "age, sire, and breeder's name unknown," i.e. the producing good hackneys is, at present, a lottery, whilst the training them is a profession which is not agricultural.

Report of the Judges of Hackneys.

Class 11. *Stallions foaled in* 1875 *or since.*—Little difficulty was occasioned to us in selecting for first prize No. 74, a black brown horse, with wonderful muscle, good feet, great action and quality—we consider him a very valuable animal. No. 70, second, was a useful horse, with good action: as was No. 71, third.

Class 12. *Pony Stallions foaled in* 1875 *or since.*—We had but three entries, which require no particular comment; No. 76 taking first prize, No. 77 second prize.

Class 17. *Hackney Mare (and Foal), above* 14·2, *and not exceeding* 15·2.—We had here two good specimens: No. 104, first prize, was a highly deserving exhibit, with plenty of substance, true action and nice quality, and a good foal. No. 106, second, was an animal with light free action, capital shoulders and excellent quality, but on close inspection was found not quite faultless.

Class 18. *Pony Mare (and Foal), above* 13·2, *and not exceeding* 14·2.—No competition; the one exhibit, No. 110, was well entitled to the first prize.

Class 35. *Hackney Mare or Gelding, not exceeding* 15·2, *up to not less than* 15 *stone.*—Three exhibits; No. 206 being an easy first, No. 207 second.

Class 36. *Mare or Gelding, not exceeding* 15·2, *up to not less than* 12 *stone.*—Only five of the ten entries showed up; No. 211 first; No. 217, an animal of good breeding, taking second honours.

Class 37. *Mare or Gelding, above* 13·2, *and not exceeding* 14·2.—Five out of the eight entries were to the front; No. 219 first, a very good animal, combining power, action, and quality; No. 221 a deserving second.

Class 38—*Mare or Gelding, not exceeding* 13·2—was well filled, both in respect to number (14) and also character. We consider it the best of the eight classes which came before us. No. 234, first prize, possessed rare form, excellent action, and plenty of quality. No. 237, second, was a worthy exhibit, with bold corky action; a trifling defect in his shoulders mainly prevented his taking a more prominent position; Nos. 236 and 230, third and reserve number, although lacking that freedom of movement essential to first-rate animals of this class, are nevertheless highly creditable exhibits.

In taking a survey of the whole of the Classes under our inspection, we regret our inability to give a more elastic Report: the exhibits, as a rule, were too limited in number, and the quality (with exceptions) was below our anticipations, as is apparent from the fact that no commendations are given.

We cannot close these remarks without tendering our obligations to the Steward of our Department for his great attention and the very prompt manner in which the well-devised arrangements of the Show were so efficiently carried out for us.

Wm. Parker.
John Rowell.

CATTLE.

Shorthorns.

But to quit the horse-classes, and to come to those assigned to the ruminants. These deserved almost unqualified praise. The Shorthorns and the Hampshire Downs were not, perhaps, so strong as is usual in the adult males. Yet both were admirably represented in the younger section; and possibly it is in these that the special merit of the two breeds may be found to lie. But it was true of all the cattle (unless the Longhorns and the Guernseys were exceptions) that, good as the adults might be, these were followed by juniors even better than themselves. The Shorthorn heifers calved in 1881 were especially remarkable for the general high average of merit throughout a very large class. Indeed, 1882 must be set down with this breed as having been a feminine year; each division of cows or heifers excelling the corresponding class for bulls. No doubt the recent regulation of the Society, which excluded bulls calved prior to 1876, kept a few old celebrities away. Yet the Exhibition in no way suffered by their exclusion. Many a bull has continued to beget good stock long after his sixth season. But it may be questioned if one was ever known to continue to increase in sightliness after that period. And there is always a certain amount of risk with an old bull, which makes him as ill-adapted to make one in a holiday crowd as was Jumbo.

Still, it remains a noteworthy feature of the year that, although

it brought out several novelties, it produced no champion bull; nor youngster likely to become one. The closely in-bred strains, as those of Mr. St. John Ackers, Mr. Hutchinson, Mr. Peel, and Mr. Pugh—which have of late produced such noble cows—have failed hitherto to yield a really grand bull. Probably "Trojan," exhibited by Mr. Ackers, is the best bull yet sent out from the Painswick herd. Yet his very best points (his early maturity and delicate quality of coat) do not indicate a very long Show-yard career.

It may be worth mentioning that whereas many of the successful females approximate to what is called "pure" breeding, not one of the prize-winning males does. Except "Trojan," and the bulls (of which there are three—"Osmanli," "Rover," and "Pearl-Dealer") descended from the elder Mr. Stratton's herd, all winners have strong outcrosses. "Lord Zetland" (probably the bull of most striking appearance in the yard) has for a grandsire one of the Sittyton bulls. "Duke Oneida" has a strong double infusion indirectly of the blood of "Romeo;" and "Bright Helm" has Killerby upon a Grand-Duke bull. "Harry Hotspur" (from Sandringham) has, by his sire, a good deal of blood foreign to the fine Kingscote herd, which produced his dam. Altogether, it may be questioned whether the very close breeding of the last ten years has not diminished the grander character of the early Shorthorns. Mr. Willis's herd (which has contributed champion bulls of late years in "Royal Windsor" and the two brother "Admirals") shows in "Major Fitzclarence" a perceptible decadence in nobility of appearance, whatever may be the result in beef. Still, it cannot be gainsaid, after the display at Reading, that the Shorthorns, as a breed, are in no danger from any rival. The substance and framework of Mr. Hutchinson's three females; the bulk of Messrs. Hosken's cow and heifer, of Mr. Bruce Kennard's "Blossom," and of Mr. D. Pugh's "Czarina Manor-avon;" the precocious ripeness of the "Ladies Carew," of "Ashton-Winsome 3rd," and of "Wild Duchess of Rosedale;" with the milk upon the Marchioness of Downshire's, Sir Hussey Vivian's, Mr. R. Stratton's, and Mr. J. J. Sharp's cows—these, with the downright prettiness of Mr. Brierley's "Snow-flake," the Duke of Northumberland's "Sunshade," of H.R.H.'s "Priscilla," of "Maid of Glamorgan," "Wallflower's Beauty," and of "Oxford Bijou," formed together a combination of charms which no other breed can pretend to supply. Without the least gainsaying the distinguished merits, for special purposes, of other varieties, so well represented at Reading, it may safely be said that the Shorthorn is still ahead of all of them for serviceable all-round qualities.

Nor should it be overlooked that, in addition to the footing now established for the Stratton cattle as a distinct type of Shorthorn of high merit, the Lake District Shorthorns continue to advance in public estimation. Besides Mr. Handley's most useful animals, Mr. R. Thompson's bull and heifer at Reading were creditable specimens of the stamp of Shorthorn which was so conspicuous at Carlisle.

Judges' Report on Shorthorns.

CLASS 39. *Aged Bulls.*—9 entries; 8 animals exhibited. This was a weak class; the bulls lacking in a great measure the form, style, and grandeur of animals we have been accustomed to see at the Royal Show. A few years ago bulls of this stamp would not have stood the chance of a prize in this class.

CLASS 40. *Bulls calved in* 1879.—13 entries; 11 exhibited. This class was an improvement on the former. Mr. Outhwaite's "Lord Zetland" is a long even bull of good quality: shoulders too heavy. Mr. Stratton's "Rover" maintains the reputation of the breeder.

There were several useful bulls in this Class, although they were scarcely up to the Royal form.

CLASS 41. *Bulls calved in* 1880.—12 entries; 11 exhibited. Mr. Foljambe's first-prize "Bright Helm" is a clever animal of fine flesh and good form, and is probably the most promising bull in the Showyard. "Baron Sedgwick," which gains the second prize, is a step higher in merit than last year; and, if he furnishes with his growth, will again prove a formidable competitor. H.R.H. Prince of Wales' "Harry Hotspur" is a good fleshed straight-topped animal, with heavy shoulders and narrow hind-quarters.

This Class was weak.

CLASS 41. *Bulls calved in* 1881.—27 entries; 17 exhibited. Mr. Ackers's first-prize "Trojan" is a first-class animal of a bad colour. The form, flesh, and hair of Trojan leave nothing to be desired. It is to be regretted that he showed signs of weakness in his hind-legs; but, as this did not appear to us to amount to disqualification, we had no hesitation in placing him first.

The second prize is a good descendant of a well-known Royal Show bull: whilst Sir H. Vivian's "Pearl Dealer" is a promising calf, which we think will be seen to greater advantage hereafter. The Class generally was not strong.

CLASS 43. *Aged Cows.*—15 entries; 11 exhibited. With one exception this was a good class. The three prize-winners are of great merit; likely to breed first-class bulls. Mr. Brierley's "Snowflake" is also good; and we wish that every dairy farmer in England possessed duplicates of "Rose of Oxford 4th," the very useful cow exhibited by Messrs. Hosken and Son. Yet size prevents her from showing that compact form which usually qualifies for a prize-winner.

CLASS 44. *Cows or Heifers calved in* 1879.—9 entries; 7 exhibited. Mr. Pugh's first-prize cow, with a name favouring the principality from which she comes, was probably one of the best Shorthorns in the Yard, and does great credit to her breeder. Mr. Ackers also won with a first-class animal in "Lady Georgina Newcomb;" whilst "May Duchess 15th," although far behind the two former cows, is a good rent-paying animal possessing much merit. We regret that we could not look upon the Rev. Bruce Kennard's "Blossom 5th" as a breeding heifer. With much that is commendable, and even good in her points, there are indications of this heifer not being in a breeding condition, which, as practical men, we could not overlook.

CLASS 45. *Heifers calved in* 1880.—17 entries; 14 exhibited. This was a good class. Mr. Ackers won first prize with "Lady Carew 9th," a very good heifer in flesh, form, and style. She was closely run by "Gertrude 5th," a fine heifer shown by Messrs. Hosken and Son; whilst Mr. Peel's "Clara Regia," third-prize, maintained her breeder's high reputation. Mr. Pugh's white heifer was in good form, but lacked quality. Col. Kingscote's "Honey 82nd," whilst retaining quality and splendid hair, seems to have lost other points. We fear Mr. Brierley was disappointed at our want of appreciation of "Miss Doncaster." It must suffice to say we did not sufficiently like this heifer to place her higher.

CLASS 46. *Heifers calved in* 1881.—48 entries; 38 exhibited. This class formed a show of itself, and severely taxed us; although we have seen certain heifers of greater merit in bygone years, we do not recollect seeing so large a class of good animals at any previous Royal Show. The first- and second-prize heifers are each very good; and admirably maintain the supremacy of their respective strains of blood. Major Chaffey's "Wild Duchess of Rosedale," and Sir H. Vivian's "Maid of Glamorgan," are also good heifers; whilst H.R.H. the Prince of Wales, the Rev. Bruce Kennard, Col. Kingscote, Mr. Outhwaite, Mr. Ackers, and others, exhibited animals which it was a pleasure to highly commend, and commend, after the prizes were awarded. We congratulate a new exhibitor, Mr. R. L. Barrow, on showing a good heifer in "Oxford Bijou," and obtaining a highly commended in his first exhibit.

On the whole, the Cow and Heifer Classes far exceeded the Bull Classes in merit; and, as this was the first occasion on which the Judges of Shorthorns have been reduced from three to two, the Council of the Society may be glad to know that we are agreed in our decisions; and had no occasion to call in the services of our "unknown referee."

HUGH AYLMER.
FRANCIS TALLANT.

HEREFORDS.

Probably, although the numbers have often been exceeded, the Herefords sustained their position at Reading as well as any other. In no other breed does there seem such an amount of beef in front. Other varieties have fine ribs, loins, and rump; and possibly rounds little inferior could be found on the half-legs of some Shorthorns; but no Shorthorn, nor yet any Devon, ever had the "beef to the ears" which some of the older Hereford bulls display. When the carcass is covered everywhere else, there is, among the white-faces, a determination of beef to the head which is quite unparalleled. Neck of beef is certainly not a prime joint: but beef is rapidly becoming a rare luxury in England; and, if it comes to be neck or nothing, even the most fastidious will probably thank the Hereford which continues to provide the neck.

In comparison with the Judges of some other varieties, those who awarded the prizes among the Herefords have given a brief report. It may be questioned if any breed showed both bull and heifer of 1881 up to level of Mr. John Price's "Garfield," or Major Howarth Ashton's "Princess." Both of these were undisputably of Hereford shape; and their shape is not, in

some men's eyes, the most sightly type. But accepting this, *pro tem.*, as being the form to aim at, no breeder of yearlings could surpass "Garfield," or, it may be said, equal "Princess." Now, to have shone so with both sexes, is what no other breed at Reading did. Mr. Platt's "Horace 4th" has gradually worked his way to the front. Third at Carlisle, he was second at Derby; and now he gets first; although, probably as a champion for his breed, he would be put behind both "Garfield" and Mr. Aaron Roger's "Archibald." Of the latter, the Judges say enough to silence other critics. Yet it may be suggested that the excellence of this bull would have been even more apparent had he, and his compeers of other breeds, been *weighed*. Mr. Carwardine's previously unbeaten "Sir Bartle Frere," seemed short by comparison with No. 396. Mr. E. Lister's "Matador" (No. 397) was curious, as illustrating one of the gradations through which the earlier Longhorn form must have been transmuted into the modern Whiteface. Mr. J. H. Arkwright showed a rather interesting bull calf in No. 411. It was half-brother to Mr. Tudge's commended cow, and uncle to the third-prize yearling bull. He was said to have been produced by an old cow which had previously been barren for five years. Of Mr. H. W. Taylor's "Modesty," and his "Lorna Doone," both of one breeder's herd, and each first in her class, the Judges speak in appropriate terms of praise. "Modesty" had a healthy newly born calf in the Yard with her (showing an unusual amount of white), to silence the frequent cavils at her extraordinary condition. Mr. T. H. Hutchinson's Shorthorns do not surpass Mr. Taylor's Herefords in this respect. Mr. Philip Turner's "Silvia" has a wonderful middle, which makes her neck seem light in comparison with "Lorna Doone's," which is extraordinarily full of flesh. The curious width of the upper part of the skull is as noteworthy a feature in this breed, as is the precocious horn with the Devon. Another "Modesty" (second-prize heifer of 1880) was conspicuous for intensely yellow horns. Is this combined with yellowness of fat, and high-coloured cream? Mr. W. S. Powell's No. 433 had great length and size for her age; and, like Lord Coventry's entries, proved that it would be very possible to breed *huge* Hereford females, did one desire it.

Report of the Judges of Herefords.

We consider the exhibition of *Herefords* quite satisfactory as regards numbers and quality, as the subjoined Report shows.

Class 47.—No. 388 (first prize), a bull of the best character, standing on short legs, possessing great substance and very superior quality of flesh. No. 372 (second prize) is very large and a good animal.

Class 48 had only three competitors, and calls for no particular remark.

Class 49.—No. 396 (first prize) is one of the most perfect bulls we have seen, possessing remarkable substance and symmetry, and being evenly and thickly covered with flesh. No. 401 (second prize) is a grand specimen. The reserve number (No. 399) we recommended for a third prize, as he has great size, excellent character, deep flesh, and good symmetry.

Class 50.—This is a good class; first, second, and third prizes, and reserved number, all possess great merit.

Class 51.—An excellent class and all commended. No. 416 (first prize), a grand cow, with beautiful character and excellent flesh. No. 414 (second prize), a very level animal, but slightly deficient in style. No. 412 (third prize), a cow of great substance and excellent character.

Class 52.—No. 425 (first prize), a superior heifer, and evenly and thickly covered with the best of flesh. No. 426 (second prize) is very massive, and will make a fine cow. No. 427 (reserve number) is full of merit, and we recommended that the third prize be given her.

Class 53.—First, second, and reserve number all possess great merit, and we strongly recommended that third prize be given to the reserve number.

Class 54.—First prize (No. 452) is a model of perfection, and second and third prizes are excellent specimens of their breed, and there are several others in this class of great promise.

Class 55.—No. 457 (first prize), a very level and good cow, with two heifer calves born in September last, and, like their dam, true in form and of excellent character. No. 458 (second prize); the dam is a large and grand cow, but one of her produce lacks style and character.

H. Haywood.
G. W. Baker.

Devons.

Upon the question of size, the remarks of the Devon Judges well merit attention. It is quite true that the size (for which critics, who deem themselves utilitarian, clamour) is a point of comparatively small importance in the closer-bred herds, whose function is to produce sires. Size can almost always be superadded by one cross; but it takes a dozen crosses to mend a faulty conformation. Therefore the epithet, "pretty little Devons," is properly used in disparagement at the Christmas Shows; but it constitutes a sneer quite out of place at a show of breeding stock. It is not likely that any one with an eye for shape will have overlooked Viscount Falmouth's two first-prize bulls "Sir Michael" and "Plum-pudding," or Mr. Bradbeer's "Nellie" (first-prize adult-cow). They were almost perfect. And that the breed is not degenerating, Mr. A. C. Skinner's first prize-yearling bull "Lord Currypool," and first-prize yearling heifer "Lady Passmore" (both of one blood), are sufficient evidence. These were both from Stowey Court. "Myrtle 7th" (of his own breeding) seemed just the heifer to put to "Lord Currypool." She has more size than is common; and an udder equal to any Ayrshire's. From two such parents the produce should equal the Hereford "Leonora" and "Princess." But the Judges of these, the Sussex and the Red-

polls, have gone over the classes of all three breeds with such particularity, that an independent observer finds little to point out.

Report of the Judges of Devon Cattle.

In making remarks on classes of animals in the position which the Devon has long held, it is well to remember that we are dealing with a breed which, as regards form and quality, has been brought to a state not readily admitting of general improvement. No marked advancement in either of these points can be looked for; but if those, whose names still appear among the present exhibitors, continue to devote their attention to the breed, there is no great fear of deterioration in any vital particular.

The Devon classes were fairly represented; and if, as perhaps it will be admitted, in quantity and quality they fell short of some former exhibitions, the fact may in some measure be accounted for by the dispersion of herds which for many years had contributed to the Shows of the Royal Society not only numerous entries, but entries of the very highest standard of merit. The absence of Mr. Walter Farthing's name among the exhibitors could hardly fail to weaken the show of Devons. From the Meeting held at Northampton, five-and-thirty years ago, to the Derby Show in 1881, the Stowey Court entries have been a prominent feature in the Catalogues of the Royal. But the herd is now broken up, to spread, let us hope, in other counties, the wide frames and fine flesh for which Mr. Farthing's Devons were famous. Other herds, as well as the older ones of the Messrs. Quartly, of Molland, and James Davy, of Flitton Barton, have also been scattered. The Flitton Barton pastures furnished the Royal Society with the winner of the first prize they ever offered for a Devon bull. This was in 1839. From that time onward this herd again and again sent the winning entries; foremost among which were the champions—male and female—at the Battersea Park Meeting in 1862; and now, three-and-forty years after their first appearance in the prize sheet of the Royal Society, the winner in Class 58 is a bull from the Flitton herd. Nor is it by single specimens that these strains were represented at Reading; for among the winners, or those that received honourable mention, eight figure as bred by Mr. Farthing, and five more came from Flitton Barton. So much for the old strains—the well-bred ones. If, however, the names of Davy, Quartly, Langdon, Farthing, Turner, and others whose representatives were found at the earlier Meetings of the Royal—if these are absent in the Catalogues of to-day, or only appear as breeders of animals shown by others,—Lord Falmouth, Sir W. Williams, Messrs. Walter, Skinner, Fryer, Howse, Bradbeer (with others less fortunate in their entries), are not likely to let the Royal Society's prizes be won by Devons without merit.

In making our awards we were at least unanimous in one thing; and that was in trying to keep our affections on those specimens of the breed which had the stamp, style, and air of "thoroughbred" about them. And here we would remark that if, to an outsider, the class as a whole exhibited a certain delicacy—a fine-drawn aristocratic appearance, a little above the requirements of the general grazier—it must be borne in mind that this is but the sign of good breeding—long careful selection; and that while it is easy enough to impart the rougher and more robust character, it is to this very aristocratic element that those who have shown larger, and what the public may term more useful animals, entirely owe their success.

In CLASS 56—the *Aged Bulls*—we selected Lord Falmouth's "Sir Michael," an animal of good character, a trifle small, yet a wondrous form of fine flesh on short legs, but scarcely massive enough for a stock bull. Mr. Skinner was second with "Fancy Robin;" not so taking to the eye as Lord Falmouth's

bull, but much better than the unlevel plain bull No. 461, which by an error appears in the Catalogue of younger bulls. As the third prize was not to be awarded in a three-entry class, unless the Judges saw especial merit, we did not go out of our way to give it in this case.

In Class 57—*Calves of* 1879—Lord Falmouth was again first with another good-looking bull, but somewhat deficient in his rump-ends. In Mr. Henry Davy's "Harry 2nd," to which we awarded the second prize, we found a larger, taller bull, but with less character, and without the smartness and cleverness of the Tregothnan entries. Mr. Walter was third with "Prettyface's Duke," bred by Mr. Farthing, but hardly up to the Stowey Court standard.

The *Bulls bred in* 1880, Class 58, were headed by "Duke of Flitton 17th,"—bred by Mrs. Langdon, and now the property of Sir William Williams—a bull of the old Davy thoroughbred stamp, and likely to be heard of again. We thought this quite the pick of the bulls; and, when he has filled round the heart, where at present he is a little bit light, he will be quite a show bull. Mr. Howse was second with "Young Nelson," bred by himself, a shade better than Mr. Walter's "Sir John," a bull out of form in his skin, and otherwise by no means a level true-made specimen of the breed.

In the *Yearlings*, Class 59, Mr. A. C. Skinner was first and second. His "Lord Currypool" was bred by Mr. Farthing, and is quite one of the good things in the Devon classes, though not so correct in character or form as Sir W. Williams's winner in Class 58. We think him, nevertheless, likely to be a formidable competitor in the Royal Showyard some future day. Mr. Skinner's second-prize animal was of his own breeding; but his bought bull was a long way the better of the two.

As a whole, the Bulls were a fine class; yet if the prize animals were to be taken out of it, there would be nothing for the Devon breeders to boast of.

Of the *Cow* Classes we may say that the first, second, and third among the aged animals were exceptionally good. Mr. Bradbeer's "Nellie," bred by himself, the first-prize cow, was a magnificent animal; few specimens in the neat stock claimed more attention on the parade than did this splendid Devon cow. With the true characteristics of the breed, weight and substance enough to satisfy the taste of the age, she was just the sort to breed the Devon ox with the baron of beef for the Royal table. Her form and grace of bearing would bear comparison with any prize mother in the Yard. Mr. Walter was second, and Sir W. Williams third, with cows bred by Mrs. Langdon, good characteristic specimens of the Flitton Barton blood. We commended the whole Class.

Among the *Heifers* were several capital animals. Mr. Skinner was first in the class calved in 1879 with one of his "Myrtle" tribe—full-sized, clever, and useful; but she got an advantage over Mr. Walter's "Lady Bearwood," second prize, inasmuch as the latter was a bit stiff and tucked up from the knocking about in her transit. Mr. Fryer was third, with a heifer which had, we believe, been placed higher in the list of honours elsewhere.

In Class 62—*Heifers calved in* 1880—Mr. Howse was first with one of his own breeding; and Mr. Walter, who appears to have purchased freely at Stowey Court, was second with "Venus 3rd." Mr. Fryer was third in this class also.

In the *Yearlings calved in* 1881, Mr. Skinner took first prize with one of Mr. Farthing's breeding. Mr. Fryer was second, and Mr. Walter third with a daughter of the third-prize bull in Class 57; whilst another of the same blood was highly commended. This was a well-filled Class—9 entries, all there; and the batch commended as a class.

Herman Biddell.
Samuel P. Newbery.
John Noake.

Sussex.

The Sussex bulls are not often handsome. The oxen are grand, and the cows stately; but the bulls, as a rule, look commoners. Yet Messrs. Stanford's "Goldsmith" is an exception. His sirloin and steaks might make the Devon men jealous; if their cattle were, as some of the best of them might very well be, put behind him. The first-prize adult-cow, Mr. A. Agate's "Snowdrop" (Peony would have been a more appropriate name), is rather blowsy, with over-protuberant hips; yet she has a remarkably fine carcass of beef. Captain Philip Green's second-prize animal was more shapely; but had lost some of her coat from scurf. Mr. J. S. Hodgson's "Laura 5th," although very perfect in form, was properly kept out of the prize-list: for she has had no calf, and shows no certainty that she now carries one. The yearling heifers were very neat; and previous judgments were frequently reversed. It is hardly possible to prevent this when a breed—as certainly is the case with the Sussex—has not yet settled down to one type. It may be said that Captain Philip Green's heifer had an unusual development of udder for this breed, which should prove a valuable tendency to milk; a weak point, it may be thought, with the Sussex.

Report of the Judges of Sussex.

Without reflecting on the owners of animals exhibited twenty years ago, no breed has been so much improved in appearance as the big Devon-like beasts now so well known as Sussex cattle. With more size, a deeper colour, higher on the leg—with less "finish"—less elegance, but of a more robust appearance, they give one quite the idea of being of Devonshire extraction. How far back the common ancestor lived we must leave to the Sussex breeders, who, at any rate, have established a class of animals of great uniformity of character, good looks, and of a most serviceable type. They have in a marked degree lost the unlevel outline which once was noticeable among them; and, while still retaining immense length, they have built up a carcass good enough for the most fastidious West-end butcher.

The eleven *Bulls* in Class 64 were quite a sight as they came into the ring. The Messrs. Stanford—whose combination of judgment seems to have brought them to the front in other classes than Sussex cattle—took first prize with "Goldsmith," a five-year-old bull; as grand good-looking an animal as one could wish to see—a winner, we understand, more than once before. The second prize went to Mr. Hodgson's "Oxford," another five-year-old; but the third was conceded to a younger bull, an animal which bids fair to become a most wonderful development of good flesh. He was only nineteen months old, and might have passed for a three-year-old. This was "Lord Oxford;" a son of the winner of the second prize, and belonged to the same owner. On the whole, this was a very grand class of breeding animals; and we distributed several commendations, in addition to the three prizes offered.

The Messrs. Stanford were first and second in the young bulls—with well-grown animals of their age, which had good looks and fair forms.

The *Cows* were not a whit behind the Bull classes in massive frames of well-

balanced meat; and, what perhaps was less to be commended, outdid them in tremendous accumulations of fat. They were, however, of symmetrical form; and one rarely meets with a deeper, fuller, or more evenly made trunk than the first-prize cow "Snowdrop" exhibited. Thick round the heart, long in the shoulder, deep in the flank, she was a credit to her breed and breeder. She belonged to Mr. Agate, of Broom Hall, Horsham. The second-prize cow was a capital specimen of the breed, but she was a little broken down behind, and would have looked quite as well if less loaded with fat. This was Captain Green's nameless No. 522, bred by Mr. Landsdale, of Bayham Abbey. The reserve number was a particularly level well-made heifer, which had the advantage in looks from not having had a calf. This was Mr. Hodgson's "Laura 5th," two years and nine months old. She was highly commended, and fully deserved her honours.

The *Heifer* classes—7 in one and 8 in another— were perhaps scarcely up to the standard of merit exhibited by the aged cows; yet they gave one the idea of thrifty profitable animals, as good for the balance-sheet as for the Show-yard. Mr. Agate, the Messrs. Stanford, and Captain Green shared the prizes.

The contiguity of the place of meeting to the locality where this breed finds favour had of course something to do with the formidable position the Sussex cattle took at Reading; but, if at future meetings the prizes are as keenly contested, it will be worth while for the Council to consider the advisability of adding another class or two for the Sussex breeders to fill.

HERMAN BIDDELL.
SAMUEL P. NEWBERY.
JOHN NOAKE.

JERSEYS.

The Judges of these have gone at such a length into the merits of individuals and of classes, and the present fashion of awarding prizes to animals of the breed is so arbitrary, that it will be best to say little beyond claiming, for their report, careful attention. The recommendations—that the expected date of the next calving among adults, should be stated, and that the in-calf heifers should be classified separately from those already in-milk—commend themselves to impartial judgment. But there is more wanted than this. Unless the brilliant prospects of this breed are to be wrecked, it is quite time to get out of the follies as to whole colours and hues, &c.; and to determine the position as to merit from produce at least as much as from form. No doubt an experienced man *can* form a pretty good general notion from what a cow looks like, as to what her yield and its quality may be. But, when positive proof can be obtained of testing comparative excellence in milk and butter, it does seem fallacious to remain content with a pretty good general notion where one might have certainty. It is with no wish to disparage the efforts which the Jersey men have made, and are making, to improve their singularly graceful and most serviceable cattle, that one says there may very easily be too many of them—especially of bulls—at a show, and in the country. Except for crossing with the Kerry (Captain Verschoyle's "Pixie," No. 825, one of the

completest dairy animals in the Show, was thus produced) Jersey bulls are undesirable neighbours. Their shape is enough to give a beef-breeder a nightmare: and their noise is the most doleful of all the sounds in the country. A baying dog is music to it. It should be added to the very careful analysis of the different classes by the Judges that, to the eye of an outsider, English air seems to improve Jersey produce. The young stock of Mr. G. Simpson and of Mr. Cardus are distinctly different cattle from those bred within the island itself. Possibly the Judges were right in awarding, as they did, the leading prizes to Jersey-bred Jerseys; but Jerseys reared in England have certainly more substance — and substance, after all, is worth nearly 9*d.* per lb. As to hues, and tints, and Guenon escutcheons, the observer who knows little had better say little. The tints are beautiful, and the escutcheons curious; but they require an education apart to appreciate their value. Their money-value—in obtaining bids—is indisputable; and most farmers breed to sell.

Report of the Judges on Jerseys.

These formed in themselves a very important Show, characterised by the presence of a large number of exceedingly good animals as by the small number of inferior ones.

It is clear that this popular breed of cattle is now very much better understood by breeders in England, and that every attention is being paid to its improvement and development.

The following are the awards in the respective classes. CLASS 73. *Bulls calved either in* 1876, 1877, 1878 *or* 1879.—This was an exceedingly good class, and contained 31 entries; indeed, this class can scarcely have been excelled at any former meeting. The first prize was awarded to No. 577, an animal whose forehand was particularly grand. It would be a long matter to particularise all the good animals in this class. The second prize was awarded to No. 562, and the third to No. 578; the reserve being No. 576, with high commendation, whilst Nos. 561, 573, and 582 were also highly commended, and Nos. 579, 580, 585, 586, and 588 received commendations.

CLASS 74. *Bulls born in the Year* 1881.—This was represented by 30 entries, the first prize being taken by No. 614, a well-bred and promising animal; the second prize by No. 611, also a well-bred bull; and the third prize by No. 599; the reserve being No. 619 and high commendation; with it were also highly commended Nos. 592 and 610, and Nos. 596, 598, 600, and 601 commended.

CLASS 75. *Cows or Heifers, in-Milk, calved previously to or in the Year* 1879.—In this class we suggest that the last and the expected date of calving should be given for the guidance of the Judges in future. It contained 33 entries, and was also a remarkably good class. The first, second, and third prizes were awarded respectively to Nos. 650, 624, and 622, all of which were animals of high degree; the reserve went to No. 634, evidently a great milker; with this cow were also highly commended Nos. 621 and 651, and Nos. 630, 642, 643 were commended.

CLASS 76. *Heifers calved in the Year* 1880.—In this class there were 41 entries. The Judges wish to point out that it would be desirable that animals in-milk in this class should not be in competition with animals

in-calf; among the latter there are many whose udders are not sufficiently developed as to be fairly classed with those which are in full milk. It is obvious that under these conditions it is an extremely difficult class to judge. The first prize was awarded to No. 665, a heifer in full milk; the second to No. 674, a heifer in-calf, a beautiful animal but somewhat too fat; and the third to No. 671; No. 673 being highly commended and reserve, whilst No. 681 was highly commended, and Nos. 682 and 691 commended.

CLASS 77. *Heifers calved in the Year* 1881.—This comprised 43 entries, the first prize being awarded to No. 723, and the second to No. 726, both good and promising heifers. The reserve was given to No. 711, with high commendation; the other highly commended animals were Nos. 695, 707, and 732, the commended Nos. 699 and 724.

EDMUND B. GIBSON.
CHAS. PH. LE CORNU.

GUERNSEYS.

It might be curious to investigate how far the allied form of the animals bred in Guernsey is owing to the introduction of Norman sires at some remote period. It is quite certain that the breeders of these most remunerative butter-makers have not sacrificed to sightliness. Their cattle look likely to pay; but they are not handsome, and they have no uniformity. Colonel Wolrond's "Romulus" (first-prize bull) might have Norman blood; whilst Mr. H. L. Green's "Rollo" (despite his name) might have had an ancestor from Ayrshire. This is not said by any way in detraction of the animal's worth and position. It is strongly believed that every type in Great Britain, and its associated islands, is the result of a fusion more or less recent; and it seems worth trying to find out what the mixed ingredients are which each so-called pure breed holds within its veins. That the Guernsey helped to make the Ayrshire is admitted: was it the Norman cross which modified the Guernsey?

Report of the Judges on Guernseys.

This section of the Channel Islands' cattle was small as compared with the Jerseys, and the task of judging was proportionately lighter.

CLASS 78—*Bulls calved either in* 1876, 1877, 1878, 1879, *or* 1880—was represented by 8 entries. The prize animals were exceedingly good, both in form and quality. The first prize was awarded to No. 739, the second to No. 744; No. 743 standing as reserve with high commendation, and No. 742 being commended.

CLASS 79. *Cow or Heifer, in-Milk or in-Calf, calved previously to or in the Year* 1879.—In this were 11 entries, the first prize being carried by No. 754, and the second by No. 751, both being excellent specimens of the breed; No. 756 was highly commended and placed as the reserve; No. 746 was also highly commended, and commendations given to Nos. 747, 753, and 755.

CLASS 80. *Heifers calved in the Year* 1880.—There were only 2 animals entered, the prize being awarded to No. 758—a promising heifer.

EDMUND B. GIBSON.
CHAS. PH. LE CORNU.

Norfolk and Suffolk Polled.

In this breed again the Judges have copiously annotated the prize-list. The cattle share with the Angus the recent improvement in value caused by American demand; an item of profit in the coming year likely to be increased by the good American harvest. What has been said of the importance of preserving in the Devon the look of a high-bred caste does not apply to the red-polled breed. This is to be a milker first: and a good carcass afterwards. It is happily free from any necessity to keep up appearances. It is of the hedge-row and the common; and, like Beranger's hero, avowedly "low." But it may be one of the most serviceable of drudges. It can live on coarse herbage, defy wind and flies, and yet get flesh and give milk. It would be a pity to sacrifice these essentials to a shade of red more or less intense, or to a neatness of form more or less complete. Mr. Hammond's bull is as neat as he can be: and his heifer calf was marked on the first day in the Catalogue "one of the prettiest things in the ring." Yet it may be doubted, unless much and good milk be provided to co-exist with these attractions, if either of these be the best type to uphold. Not of late years—but a century ago—breeders of large flat-sided polled cattle existed in the county. The portrait of a bull of this breed is given in Mr. Storer's book, copied from a picture at Gunton. The colours were mixed, but they were all polled, all hardy, and all milkers. It would be at least as good an aim to set before one (as Mr. Lofft seems to have done), to recall, as far as possible, these peculiarities for the rising breed of the Eastern counties, as it is to endeavour to create a race which shall simply be a dishorned Devon. There once were polled cattle in Devonshire; was a cross from these introduced into Norfolk, when Devons were in fashion there?

Report of the Judges on Norfolk and Suffolk Polled.

In these classes also we noticed a marked improvement. Hardy, hornless, excellent milkers and good graziers, the Polled Reds are gaining ground. With the 34 entries—5 less than the Sussex breeders sent, and 10 short of the Devons—the Council find their efforts to bring out the breed well responded to by the Eastern counties.

There were eight *Old Bulls* shown in Class 81; but the animal which has been winning in the home circuit was excluded by one year's age. There is a great uniformity of character among them; they have now for many years been carefully bred; and, thanks to Mr. Euren of the *Norwich Mercury*, three volumes of a well guarded herd-book have been published, whilst a fourth is in preparation. The bulls selected for prizes were excellent specimens of the breed. Mr. Hammond's "Davyson 7th" took first prize, beating Mr. Colman's "King Charles." The former is a very neat true-made bull, with

good flesh, good colour (Suffolk and Norfolk breeders are very particular as to this), and a right well-bred style about him. He is a little short in his hind-quarters; and, like some of the Sussex bulls, has a tail pushed far back into his rump. "King Charles" is two or three years his senior, and is on a larger scale, with more frame, heavier, bigger all over than the "Davyson" bull ever will be. He is grand in his walk, but drops his back when at ease; and, to judge by his dual leaders, he shows a bit of temper at times.

The *Young Bulls* were hardly up to the class of old ones; although Mr. Taylor's first-prize "Passion" is a clean-made, good-looking bull, with plenty of quality, but has a slight stain of dark on his nose. Mr. Lofft, of Troston Hall, near Bury St. Edmunds (who has the largest herd of the breed in England), was second with his bull-calf "Cortes," something under a year old. This may grow into a useful animal, but is flat in the fore-ribs, and has a plain head. Mr. Colman's "King Charming" takes the barren honour of reserve number; and is a straight-backed, deep-ribbed calf, with a tendency to be poddy. He has a nice level outline and good hair. He comes from the same herd as the second-prize old bull, but is of another strain.

The *Cow* Class was headed by Mr. Hammond's "Davy 18th," as true a made animal as any in the Yard. This, however, was not a unanimous decision; one Judge objecting to her faulty milk-quarter, and a certain technical defect not so objectionable to those outside the Eastern district as to a polled breeder. A protest was lodged against her as having been exhibited at a Fat-cattle Show.* Mr. Colman's "Cherry Leaf" was more of the Red-polled character; and, though far short in form to Mr. Hammond's cow, looked a more profitable animal for the dairy. She was awarded second prize; the reserve number and highly commended going to Mr. Taylor's "Flirt," a winner at last year's Royal at Derby, but sadly patched with fat round the tail. Mr. Lofft's "Minnie 6th," a cow tracing back to Lord Sondes' breed, was highly commended.

The Duke of Hamilton showed his "Katie's Sister" among the *Two-year-old Heifers*; and here she won first prize. She is level, smart, and good, with a little white on the udder; and is a well-bred, thick-fleshed heifer with plenty of quality. Mr. Amherst (who is forming a very choice herd from selections from the best breeders in the district) was second with a Troston Hall bred one. This, shown without much preparation, was a promising heifer.

In the next Class—*Heifers calved in* 1881—Mr. Hammond was first with "Davy 37th," about as true-made a calf as could be found under the Reading canvas. Mr. Lofft was second with a nice thrifty heifer, which he sold, with another, to cross the Atlantic. These hornless beasts are coming much into favour with American farmers.

Altogether, the show of Norfolk and Suffolk Red Polled cattle (pity the breeders of these animals cannot express the name of their class under five words) was a creditable display. As one of the few breeds—the only one of *English* cattle—which are polled, they are taking a fair place in the secondary catalogue. They stand well as milkers; occasionally graze to great weights; and fight the poor low wooded meadows, in Norfolk and Suffolk, better than anything else. Their Herd-book has done much for the breed, in and out of the district where they are bred; and prices are now realised, for the best specimens, which were quite unknown in bygone years, when no farmer in Suffolk gave more than nine sovereigns for a bull; and, as Arthur Young wrote, "no breeder used one for more than a year," so none knew which were worth keeping till it was too late to decide.

In presenting a joint Report there is always a difficulty in giving remarks,

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* This protest was sustained after enquiry of the exhibitor, who expressed ignorance of the Society's rule on this subject.—EDIT.

applying to individual cases, unanimously endorsed by three separate Judges. Might it not be an improvement if they sent in separate Reports?

HERMAN BIDDELL.
SAMUEL P. NEWBERY.
JOHN NOAKE.

LONGHORNS.

The exhibition of this variety is always instructive, if only to show what advance has been made since the days of Bakewell. There is no reason to believe his breed has deteriorated. The difference in the relative position of this and later introductions to public favour has been caused by the improvement of the latter. But the milk which once certainly did belong to the Longhorn was not to be seen at Reading. The display of promise for this could not be compared even with that on the Hereford, which is probably the best development of the old form of Longhorn; whilst the growth of the younger classes (bulls especially) was far behind that of the specimens of any of the rival breeds. Neither the first-prize bull nor first-prize cow were of the brindled colour once associated with the old Longhorn. They were red and white, and, for that reason, they did the better display the relationship of the Hereford to the older variety. Except for its hardiness, and perhaps for making certain kinds of cheese, the Longhorn is now so far surpassed, that it ceases to have more than an historic interest for the general public. But no national show would be complete without some specimen of what was *once* the finest breed of cattle in England, and probably in the world.

DAIRY CATTLE.

The animals included in these two classes formed, as a whole, a capital illustration of the wealth of milk-makers which this country possesses. The decisions, in the absence of any register of produce, are inexplicable. The Marchioness of Downshire's cow and heifer (each first prize) were capital dairy cattle; but why they were better than Mr. Phillip's good red Turnell Shorthorn, or than Mr. Ferme's admirable Ayrshires (or even Captain Verschoyle's "Pixie"), did not appear. All those named were prize-takers: yet behind them (and *to the eye*, not less meritorious) were Sir Hussey Vivian's and Mr. R. Stratton's deep-milking, well-fleshed Shorthorns, which had no word of commendation given to them. This may be right, but it is difficult to understand why it was right. So long as classes *for special purposes* continue to be judged, without any public intimation of the extent to which those special purposes are accomplished, there must be discontent. Why were the

prize-takers better milk-givers, butter- or cheese-makers, and possible carcasses, than those unnoticed?

Report of the Judges on Longhorns and Dairy Cattle.

In the *Aged Bull* Class four animals made their appearance. No. 546 was superior in quality, although crippled in his forelegs; the second prize went to a bull of very nice quality. The reserve was given to a very masculine animal, but very deficient in quality.

Class 70.—Only two animals came into the ring. The Judges considered the quality and colour of No. 547 preferable, and awarded him the first prize. No. 548 was a strong good animal, and we recommended the second prize to be awarded.

Class 71.—*Cows* were limited in numbers. The Judges considered the two prize animals to represent the Longhorns satisfactorily.

Class 72.—Only two *Heifers* were exhibited, which were very good. The Judges recommended two prizes to be awarded. The third entry was absent on account of lameness.

Class 86.—*Dairy Cows in-Milk* had a full entry, comprising animals of various descriptions, from the diminutive Kerry to the Shorthorns. In this Class the Judges were directed to pay particular attention to their milking properties; and their awards were made in accordance with these directions. The first prize was awarded to a roan cow with a very well-shaped udder, and a beautiful animal. The second was a good specimen of a Shorthorn dairy cow. The third prize went to a very nice Ayrshire, with capital milking qualities, and was giving milk with greater density than many in her class.

Class 87 was of rather a meagre description. The first prize was awarded to a red heifer, with a well-shaped udder; and giving promise of growing into a very good cow. The second prize was awarded to a Channel Island heifer, with superior milking qualities; and the third prize was awarded to an Ayrshire with good milking properties.

John Denchfield.
J. H. Burbery.

SHEEP.

Leicesters and Lincolns.

As of the cattle so of the sheep: the Show was comprehensive and characteristic. The main types were well displayed, and the young classes were in advance of, rather than behind, their elders. The honour involved in saying "After you" is duly paid—as it ought to be among Longwools—to the Leicester, Bakewell's favourite breed, and the subject of those intelligent experiments upon breeding which have yielded such mighty results. How long the Leicester will survive in a pure state cannot be conjectured; it seems now to be retained in very few hands; and, although one hears—as this year—of the dispersal of yet another flock of ancient lineage, there are few indications of fresh supporters. As Border Leicesters or Lincolns, it is probable that the breed will be continued longer than in the purer form; but, whatever may be their destiny "in the flesh," in history the position of the Leicester must remain unique. It

will be seen that the Judges did not think the Reading Show indicated rapid decline; although "thin in the neck" and "too narrow" are not comments of good import. Messrs. J. and D. Linton (who are new exhibitors of the breed at the Royal), by winning two first and one second in the three classes, have evidently taken the highest place in the present season. Mr. T. H. Hutchinson fights up as manfully for this old Yorkshire favourite breed as he does for Shorthorns; but it is to be feared that the enormous imports of colonial wool, and improved notions of the cook's art, will drive out of cultivation the parent and improver of all the Long-fleeces and of all early matured mutton. Probably the Cotswold is as old a breed as that experimented on at Dishley; very possibly it is of the same origin. It seems to me that there are but two or three types at most of any of our farm-stock, and that the sub-varieties have been produced by introducing to an earlier form, in more or less proportion, the blood of a later arrival into this country. Very probably—but it is not yet a point which can be ascertained—it will be found that the dark-faced sheep, dark-hued cattle, and dusky swine, approximate most closely to the animals which accompanied the earliest invasion of Britain which came from the South; and that the light-coloured and thick-fleshed, and long-haired and woolled breeds came in later with the introduction of the northern hordes. This speculation is, however, rather outside the duty of a reporter at the Royal Show at Reading. Yet, as it seems to me, no intelligible story can ever be told of the various breeds of anything which now exists on the island, except upon the notion just referred to; i.e. that each—as we now find it—represents the modification of an earlier type, and has been produced by the alliance with a successor whose ancestry have passed through different climatic influences and experienced different human management before it arrived in Great Britain.

The Lincolns, rightly or wrongly, have acquired the credit of having the best mutton of any Longwool breed; as they have of carrying the heaviest fleece. It is a common fact that, for some unexplained reason, these excellent sheep are never allowed to be seen without having been tinted with a brown grease. How far, if bleached like a Cotswold, their breeding would be admitted to be pure, seems to be a question worth solving. Suppose the Society were to determine that—as the historian of Sockburn suggested with respect to cattle—

> "That Judges, out of Lincoln,
> Decide the Cotswold prizes;
> *Atque vice versâ*
> As equity advises"—

it would be curious to see how far the winners would alter the colours under which they sail. But perhaps it would be better still to allow a company of Border Leicester Shepherds to turn out the competitors for Lincoln, Cotswold, Kentish, and Devon prizes; and then see how far these "different" breeds would be found to vary, if all the rivals were exposed to one and the same treatment. Mr. Garfit failed to secure the same place at the Lincolnshire Show, which he won with general approval at Reading; but Mr. Henry Smith's magnificent old sheep were as invincible at home as they are outside the county. Mr. Pears, too, is not to be beaten in his own district; although strangers involuntarily mutter that his beautiful ewes would look all the better for a copious dressing with his namesake's soap. If that would make the Lincolnshire prize-winning sheep as clean as Cotswolds, there would be no further necessity for the employment of the famous placard of "You dirty boy!" It will be noticed that, although there was no competition in ewes, the Judges thought the merit so great that both prizes should be awarded.

Report of the Judges of Leicesters and Lincolns.

Taking the Leicesters as a whole, we consider them equal to most of the later exhibitions of the Royal Agricultural Society.

Beginning with the *Shearling Rams*, the first-prize sheep has a remarkably good loin and hips, very nice fleece, head well put on, but neck rather too small. Second-prize sheep, a nice level animal, but too narrow. First-prize two-shear ram, fine in form, with very good flesh and wool, but rather small:—a true Leicester. Second prize rather loose in his mutton. Amongst the *Shearling Ewes* the first three pens placed were of very nice character.

Of the Lincolns the first-prize *Shearling Ram* is an animal of great promise. The second-prize sheep is also of good type. The first-prize two-shear ram is a sheep of exceptional merit, well supported by the second and reserve number. There were only two pens of *Shearling Ewes*. The Judges, however, strongly recommended the second prize being awarded, there being sufficient merit in both.

H. Mackinder.
Wm. Sanday.

Cotswolds and Lincolns.

The Cotswolds, old and young, were magnificent. It is to be understood, however, that "young" has a different meaning here from the word when used in connection with Hampshire and Oxford Downs. These two breeds maintain classes for lambs of the current year. All the other varieties have failed to justify the apportionment of such classes to them; the ewes not milking well enough to force the lambs into distinction by July. By general consent the Cotswold classes were *the* sight among Longwools in the Reading Yard. If one wondered at the Lincolns, which certainly were of great size

and greater promise, one was told to go to their County Show and look at them there. But no one ever ventured to suggest that a finer lot of Cotswolds would be found this season wherever one might go to look for them. The custom, too, of the breeders of this variety—to do no more to set off their flocks than simply bleach their fleeces — seems prepossessing, after the evident trickery with which pens of other breeds have been manipulated before the public are admitted to see them. The success of Messrs. Jacobs as breeders, in 1881, was very marked. Both tups and ewes of that season, from their flocks, were first in their class. It is to be regretted that the entry forms for sheep do not include references to the breeders from whom grandsire and great-grandsire came, so that the merit done may be properly apportioned ; at least half the credit of a winning pen belongs to the breeders of its parents.

A further subdivision of Longwools is recommended ; because the style of sheep which suits the mild pastures of Devon does not find itself happy in Romney Marsh. This would be an excellent plea, if made use of for a Show about to be held in Kent or within a short distance of Exeter. But, as regards the country at large, the difference between such purely local sub-varieties does not seem worth taking into account. If either of them need acceptance outside its own district, within which it is acclimatised, it should prove itself fit to compete with other Longwool varieties, between which, it must be repeated, the divisions already are, in my opinion, far more artificial than real.

Report of the Judges of the Cotswold, Kentish, Romney Marsh, and other Longwoolled Breeds.

The class of Cotswold sheep was much above the average in point of numbers and quality ; and the general excellence of the breed was well maintained. The Judges recommended that, owing to the large competition in Class 91, a third prize should be given in this class to No. 883.

In the class for *Kentish, Romney Marsh, Devon* and other *Long-woolled Breeds,* the Judges recommend that, at future Shows, the Devons and Kentish breeds should have separate classes; for it is difficult to judge between sheep so different in symmetry and character; whilst no doubt each is a useful breed in its district, and both are well worthy of the support of the Society.

ROBERT GARNE.
AMBROSE WARDE.

OXFORDSHIRE DOWNS.

Possibly, as Oxfordshire sheep are more of a long than of a shortwool breed, and as the Shropshire, too, indicates a not distant alliance with its fleecier rivals (the Devonshire Longwools), these two varieties may with justice be introduced, above the Southdown, among Down sheep, to break the transition from

one type to another. But on no other grounds can the position be justifiable; the Sussex is as much the nearest approximation to the original Shortwool type as the Dishley breed is to the best properties of the older Longwool variety; and, upon its own soils, and for its own purpose, the Sussex, or Southdown, is still quite unsurpassable; and ought, as the oldest, to take the lead. It has lent something to every other Down breed, but it is doubtful if it ever has been paid back by any one. The Oxfordshire Down contributed about thirty pens of shearling rams; besides large classes of ewes, and lambs of both sexes. This, but for the fact that at Reading they were "at home," would argue a great increase in support for the Oxford breed. Nor can it be questioned that the breed does and ought to gain ground. It has all the merits of the Shropshire, and more size. It has also been found, in some strains, to milk above the average; and to produce very fine lambs before midsummer. The entries at Reading were, with one or two exceptions, fairly uniform; but the establishment of the breed is still too recent to allow of any fixity of type. Still, it is noticeable that Mr. Treadwell (who did not exhibit lambs) took both first prizes for tups; and that he was highly commended for the only pen of ewes exhibited; whilst he put on record, in the Catalogue, that his first-prize shearling is by a rival's (Mr. Howard's), No. 25. Mr. Treadwell's two-shear tup was bred by himself from his own stock, and was specially mentioned as being of "excellent type and far above others in the class." The absence of weight (so much to be regretted in each department) prevents one from instituting those comparisons with Shropshires and Hampshires at similar ages, which would be so instructive. Mr. A. F. Milton Druce was just as conspicuously first in his lambs of 1881 as Mr. Treadwell was in older classes; and it is worth noticing that, to gain the two first prizes in close competition, he entered only one pen in each class.

Report of the Judges on Oxfordshire Downs.

The Judges are of opinion that the *Shearling Oxfordshire Down Rams* were a very strong class, and a credit to the breeders; being of great size and good quality. In the older class of Rams, the first-prize ram, we consider, is an excellent type of an Oxfordshire Down; far superior to any other in the same class. The *Shearling Ewes*, with one or two exceptions, were an excellent class.

The Classes 103 and 104, *Ram and Ewe Lambs*, were good classes, and of great promise.

J. P. Case.
H. Overman.

SHROPSHIRES.

The Shropshire competition was really overwhelming. There were seventy-two entries in the Class for Shearling Tups; and Mr. T. J. Mansell, entering four pens, obtained first prize, two highly commendeds, and a commended. This, too, argues taking a lead for this season; although Mr. Matthew Williams (who got second prize and reserve number with two out of three entries) can hardly be put far behind. His sheep *seemed* bigger than Mr. Mansell's, of which the chief feature was their very neat heads and general Southdown character. By the lamented death of Lord Chesham seven fine rams were kept away. As an indication of the amount of money which is now dependent on the success of one of these ram-breeding flocks, it may be stated that the earnings for service by Mr. T. S. Minton's first-prize two-shear ram (which was the first-prize shearling at Derby) amounted to above 200*l.* in one season. This may not equal the prices of the old Bakewell days, but it is within "measurable distance" of it. Mr. J. L. Naper, who was twice highly commended for Shropshire sheep sent from county Meath, was one of the few Irish members of the Society who contributed to the Reading Meeting. The entries from the sister island were sadly missed; for these have rarely failed, of late years, to include two or three prize-winning Shorthorns. And one of these good bulls—like "Anchor" at Kilburn—would have given quite a fillip to the Show. Is it because the Shropshire ewes do not milk well that no lamb-classes are set apart for the breed? They have been repeatedly introduced into Norfolk for breeding half-bred lambs; but, so far, they have failed to hold their ground as against the Hampshire and the deep-milking, long-legged, Suffolks.

Report of the Judges of Shropshires.

CLASS 106—*Shearling Rams*—contained 72 entries, but owing to the lamented death of Lord Chesham and other causes, several pens were empty. The first prize was awarded to No. 1074, a sheep of wonderful quality, not perhaps of so large a scale as others in the class, but nevertheless a capital specimen of the breed. The second prize was awarded to No. 1092, a ram more massive and of excellent quality. No. 1056 took third prize, a grand sheep, with excellent wool and mutton.

The numerous commendations testify to the superiority of this Class.

CLASS 106. *Two-Shear Rams.*—The recent decision of the Council confining the competition to two-year-old sheep (a step which the Judges fully endorse) no doubt had a tendency to decrease the number of entries. The first prize went to No. 1108, the same animal which won first in a very large class at Derby last year, and which has developed into a very grand sheep. No. 111 took second prize, a ram with a wonderful head and neck,

and nice quality of wool. The third prize was awarded to No. 1112, a fine well-grown stylish sheep, with a good back and good leg of mutton.

Class 107—*Shearling Ewes*—was an excellent and large class, no fewer than 110 being entered. No. 1119 easily took first prize, being ewes of great size and excellent quality. The second prize was given to No. 1126, a pen possessing fine quality and splendid wool. No. 1128 pen contained five ewes of excellent type and good Shropshire character.

Altogether the breeders of this rising and rent-paying class of sheep fully maintained the prestige they had previously obtained in the Royal Show-yard.

Peter Everall.
Charles R. Keeling.

Southdowns.

The South or Sussex Down furnished a remarkable display; although it may be said that such Shropshires as Mr. Mansell sent apparently equalled the best Southdowns in neatness and excelled them in size. One writes "apparently," because it becomes yearly more and more obvious that the skill and judgment with which the shears and felting-irons are wielded by the shepherd, have no small share in the results on the judging day. No one can even guess what these sheep weigh. In the absence of weight, no one would be inclined to say that the Sussex —except Mr. Colman's ewes and a pen of even finer natural character sent from Goodwood—seemed to have lost size and lean meat. The Judges (and it is a most grave caution) mention their impression that good legs of mutton are less noticeable with this breed than they were. If so, the aristocratic patronage of the last few years has done the breed no good. As it seems to me, the Judges at the Royal might fairly be required to notice every pen of sheep which is up to a certain standard and not liable to disqualification. When from forty to seventy tups enter for three prizes, the number of disappointed folk *must* be large. It would smooth down many ruffled feathers if highly commended and commended cards were more freely dealt out to those not undeserving. The entries sent from Cambridgeshire by the two Messrs. Jonas, by Mr. Gorringe, and by Mr. C. Chapman, and the Duke of Richmond's rams, seemed too good to be passed wholly over in silence, because none of these flocks own quite such miracle-working clips and tongs as some of their more practised rivals. There is not one of the flocks named which does not send out most excellent Down mutton, such as Dr. Brighton loves.

Report of the Judges of Southdowns.

The Classes of Southdowns were fairly well filled; all the principal flocks being represented. The Judges are of opinion that they have seen more uniformity of character in a Show of this prime and valuable breed of sheep. There were also sheep—in all the classes under their notice—which, having the

level back, the good touch, and other fine characteristics of the pure Southdowns, yet lacked the robust development which it is now necessary to acquire to get to the front in the Showyard.

CLASS 128. *Shearling Rams.*—There was a large show in this class, numbering 42 entries, and comprising some fine specimens of the breed. The first prize went to a grand young sheep, level, long, and wide, and of fine type. The second was a clever sheep of very nice quality. There were many others of considerable merit. No. 1168, which was highly commended, was a clever little sheep of pure Southdown character, but was small. The Judges could not but observe that many sheep of considerable merit, with good backs, good rumps, and plenty of character, were a bit light in their legs of mutton, an important point in a Southdown.

CLASS 109. *Two-Shear Rams.*—This was not a strong class. The first prize went to a heavy thick-fleshed sheep, with remarkably good hind-quarters. The second-prize sheep had a splendid back, with well-springing ribs, grand fore-end, and good male character, but rather light in his leg of mutton.

CLASS 110. *Shearling Ewes.*—There was an entry of 15 pens of very good ewes. The first-prize pen were extraordinarily heavy and well-formed sheep, with great constitution and good quality. The second prize went to a pen of strong clever ewes with great character, and looking like breeding prize rams some day. The third-prize pen was a very nice matching lot, of fine quality. No. 1210 (highly commended) was a pen of ewes with long level backs, well-sprung ribs, and wool of the finest quality; but, being rather light of flesh, did not show so well as some ewes of less merit; they were, however, grand Southdown ewes. There were other pens of ewes of considerable merit; and it was altogether a good class.

JOHN A. HEMPSON.
THOS. FULCHER.

HAMPSHIRES AND OTHER LONGWOOLS.

The older Hampshire Classes were a great disappointment. So much interest has been awakened by the most wonderful lambs sent to London in May and June, and by the pens shown at Islington in December, that not a few visitors came to Reading expressly to see the Hampshire rams and ewes. There were none of the latter which had had lambs this season; and not above two or three good old rams. The ewe- and ram-lambs, being excellent, made amends; but one would have liked to have seen the parents from which such lambs were reared. Mr. W. Parsons (although one of his pens of ewes was disqualified by the Judges of Shearing) stood at the head of three classes; and Mr. A. Morrison, whose feats with the breed have excited great wonder, was ahead with shearling tups; whilst Mr. H. Lambert (who runs the breed through all East Anglian Showyards) quite held his own with the local leaders. There can be no question that this breed is good, and also that it is distinct. It would be a great gain if one could get the breeders of them to trust to onlookers to find their entries out without daubing all their lambs with red ochre to mark them out from their rivals.

Two pens of the Devonshire Horned Sheep were sent by Lord Poltimore; but no pen appeared of the pink-nosed Dorsets, which probably represent a specially selected and developed outgrowth of this most useful old breed. And, in spite of the absentees, and of the most objectionable practices on the part of some of the keepers of the pens which came, there was no department at Reading of more cheering import than the Sheep Classes. These told that the rot of 1879–80–81, which ruined hundreds of farmers, has not also ruined the breeds of sheep of this country. Sheep are now as good as ever in quality, if fewer in number. It is a sad pity that some of those who once owned the flocks cannot be as easily restored to the positions which they once held, as have been the sheep themselves.

Report of the Judges of Hampshire Down and other Shortwoolled Sheep.

CLASS 111.—Badly represented; two good sheep. First prize, a remarkably good sheep, plenty of length, symmetry, and good wool. Second prize, also a good sheep, with good coat and quality.

CLASS 112.—Badly represented; only one good sheep, and that was disqualified from a disease.

CLASS 113.—Not largely represented; only 5 entries, one disqualified; but a very good class. First-prize lot a superior pen of ewes.

CLASS 114.—A good entry; general good class; and mostly of very superior quality.

CLASS 115.—A very superior class; of good quality and well represented; the best class of all.

JOHN G. KING.
F. BUDD.

Report of the Inspectors of Shearing.

We have completed our inspection this morning, and would recommend that No. 835 (CLASS 55), No. 1117 (CLASS 107), No. 1231 (CLASS 113) be disqualified.

July 10*th*, 1882.

JAMES E. RAWLENCE.
J. B. WORKMAN.

PIGS.

The ingenuous rustic (if such a being still survives) who should pass from the pens of sheep to those of swine, would find himself sorely puzzled to determine where wool ends and hair begins; and where the line is drawn, by the Judges, by which they determine what amount of fraud shall constitute disqualification. Some of the small breed of White Pigs have a coat so curly and shiny that it might almost pass for a lustre-fleece; but whereas sheep are tolerated when tinted with every hue of the rainbow, a Berkshire pig was turned out of the prize-list because the white tip to his tail was artificially produced. As it would seem, water-colours are admissible, but not paintings in oil. As the matter looks now, the toleration

of the Council of the Royal Agricultural Society—their unwillingness to fetter exhibitors unnecessarily in their endeavours to set their entries off to the best advantage—must quickly find its limit. The very necessities of agriculturists should urge men, whose offices are created to promote the interest of agriculture, to step in to check practices which discredit the whole system of showing, and which jeopardise the trade in live-stock with foreigners. The Royal Society virtually says to farmers, "See, there are the animals you should breed;" and to strangers who come to buy, "These are the best that England can produce." And when the farmer comes to look, he finds an amount of trickery (not to say cruelty) practised which would get a country dealer hooted out of a pothouse; and when the foreign buyer examines his purchase, he finds he has been taken in like the buyers of a painted bird in a London park or square. Does any one really believe that pigs—whose snouts are to them much what their trunks are to the elephants—are the better because their noses (partly through breeding for malformation, but partly, too, by downright fracture) are made useless? A more pitiable sight than a pen of prize pigs does not exist. They can hardly breathe: they can't feed themselves except from vessels specially formed to help their monstrosity: they are all blubber, with little of the lean flesh which is wholesome food for men. As well reward cows with an abortive udder, and horses with malformed feet, as pigs for short faces. Every right feeling is in revolt against all this nonsense. Either let pigs be left altogether to the managers of booths at country fairs; or let such as are rewarded at the Royal Exhibition of Agriculture be genuine farm-stock; such as could pick up the scattered grain and put it to good account, can graze the pastures or turn up the litter in the fold-yard after the fattening cattle. The Berkshires were all this, and so were the Large Whites. But the curse of fancy points is corrupting the former. The display of Berkshires at Reading was magnificent. It is a thousand pities that it should be hinted in disparagement of a really grand boar and sow, that this or that was not "quite correct in its markings." What have markings to do with merit in a pig, except perhaps streaks in the bacon? The Report of the Judges of Pigs is so full, and so authoritative, from the position which these gentlemen held, that it does not seem necessary to do more than make these general statements.

Report of the Judges of Pigs.

With the exception of the International Show, held at Kilburn, the entries of pigs at Reading were more numerous than for some years. This may, perhaps, be partially accounted for by the introduction into the prize-list of classes for Middle White Breed Pigs, and by the fact that the Show was held in the home of the Berkshires, which mustered so strongly, both in numbers

and quality, as to render the display one of which the various exhibitors might justly be proud, but for the markings, which on some of the otherwise best specimens were very imperfect, and materially affected their position in the prize-list. The Small Blacks were a decided improvement on those exhibited at Derby and Carlisle. There is still great diversity of type amongst the animals shown in the various classes; this renders the duties of the Judges more difficult, and tends to cause slight dissatisfaction amongst some of the exhibitors, who each imagine that their particular fancy is the "correct thing."

We regret to be compelled to report that the show of White Pigs of the various breeds, except the first-prize winners, was not so good as we have been accustomed to see at the Royal, if we except the class for Sows of the Small White Breed, which we commended in its entirety; and in the class for Middle Breed Sows we had very great difficulty in finding animals sufficiently good and true to breed for second place. There would, of course, be many and diverse opinions as to the cause, but we are inclined to think that one of the principal reasons is the great foreign demand for really good and pure bred pigs of the various breeds.

Class 119.—The first-prize young boar is of great length and of good quality; the one placed second has more of the Middle Breed character.

Class 120.—The same remarks will apply to this class.

Class 121 contained nothing very striking.

Class 122.—A grand sow took first prize; the second was somewhat weak in the loins.

Class 123.—Poor class.

Class 124.—Three of the five entries were absent.

Class 125.—Very moderate.

Class 126.—The first-prize sow was very good; the second was of a good type, but weak in the loins and girth.

Class 127.—Again but one really good animal in the class.

Class 128.—First prize very good, and a true type of a small breed pig.

Class 129.—One pen far better than the others.

Class 130.—The only superior class amongst the White Pigs; the winners of the first, second, and reserved cards were very nearly equal in point of merit; there were also some very good sows not fortunate enough to get a place in the prize-list. Class commended.

Class 131.—A large entry for Blacks. We awarded the first prize to a very thick-fleshed pig, wonderfully good in loins and hams, and with well-sprung ribs, but rather light in the neck; the winner of the second prize was also a very good pig of a different style.

Class 132.—The boar which won the first prize at Derby in the class for young boars easily repeated his victory to-day when shown in the class for older pigs.

Class 133.—First- and second-prize pens were good.

Class 134.—A very good class, with twelve entries.

Class 135.—Twenty-one entries, and at least five of the exhibits were good enough to win a first-prize at an average show of Berkshires at the Royal; a third prize was recommended.

Class 136.—Not so good as a class; the first-prize boar was decidedly the best, but he was not quite true to marking.

Class 137.—We noticed nine of the twenty entries, eight of these for *natural*, one for *artificial* merit.

Class 138 was a grand treat for admirers of good pigs; the whole class was commended, and a third prize asked for, so good was the class.

G. M. Sexton.
Sanders Spencer.

Report of the Veterinary Inspectors of the Society with reference to the Dentition of Pigs exhibited at Reading.

THE STEWARDS OF STOCK.

GENTLEMEN,—In accordance with condition No. 20 applying to Pigs, we have to report that the state of the dentition of the Pigs in the under-mentioned pens indicates that the animals are above the age stated in the Certificate of entry, viz.: Pens 1265, 1269, 1271, 1286, 1289, 1291, 1322, 1336.

The objection to Pens 1286, 1289, 1291, refers to the young pigs exhibited with the breeding sows.

In condition 21 it is stated that the young pigs must not exceed two months old, whereas in Pens 1286, 1289, the dentition indicates three months, and in Pen 1291 some of the teeth which indicate five months are cut. We submit that the pigs in the Pens 1265, 1269, 1271, 1286, 1289, 1291, 1322, 1336 be disqualified. We have further to note—that the dentition of the pigs in Pens 1268, 1278, 1279, 1283, 1309, 1321 is exceptionally forward even for pigs of the White Breed, but in consideration of the very slender doubt which may exist, we omit these pens from the list of those to be disqualified.

G. T. BROWN.
WM. ROBERTSON.
W. DUGUID.

BUTTER AND CHEESE.

If the Judges, with full opportunities of touching and tasting, cannot say more than their reports contain of the butter and cheese exhibited, a mere looker-on can hardly be expected to be diffuse in his comments. The great want of English dairymen is attention to the little arts which are required to make their excellent produce appetising. Tubs of butter and cheeses, big as a mill-stone, are serviceable, but not attractive to the consumer.

Report of the Judges of Cheese and Butter.

In making our Report upon Cheese (CLASS 39), we must first express our regret that a larger number of entries were not made for competition.

With all the new developments and inventions of daily food, cheese continues to hold its place, being one of the handiest and most economical for the consumer.

The early period of the year at which this exhibition takes place is somewhat of a disadvantage to this article, as many lots would naturally have shown greater merit had there been more time allowed for them to mature.

Taking into account, however, all the drawbacks, the samples, on the whole, were creditable to the makers.

The low temperature of the preceding night had the natural effect of showing off the entries of butter to the best advantage.

At the same time due allowance must be made for those samples which, coming from a long distance, were necessarily confined in packages which allowed of no ventilation of fresh air. Consequently many specimens were in a soft condition.

Considering that the Royal Agricultural Society of England held its Show

this year in a district which should yield large supplies of this commodity, we feel disappointed that the exhibits in general were not of a higher class quality.

JOHN EASTTY.
JAMES HUDSON.

FRUIT AND VEGETABLES.

The Classes for minor Farm-products would have been disheartening did not one remember that the function of the Society is almost as much to ascertain deficiencies as it is to reward successful exertions. At the lowest estimate it cannot be said that farm fruit and vegetables showed worse at Reading than did classes for dairy cattle at Carlisle and Derby. Yet the latter have grown, by 1882, into a really fine display, in which nearly all the milk-breeds had characteristic specimens; and it may be hoped that, before 1884, growers of fruit and vegetables will have learned that the knowledge how to show their produce to advantage is more than half the road to profit. The very best of such perishable wares can be rendered unsightly, and made unsaleable, by neglect of the common precautions taken by any Covent Garden fruiterer. Not merely were there but few entries (only sixteen of fruit for thirty-two prizes, and eighteen of vegetables for thirty prizes), but of the entries sent, nearly half came from one grower. And, of his few rivals, more than one "lumped" his lot of fruit or roots down, upon the Show-bench, with less attention to appearances than a costermonger upon the ground of a race-gathering. It may be questioned if the Society be right in expecting that large quantities of soft fruits can be kept from fermenting and spoiling in a four-day Show. Except some red currants, and a box of well-kept specimens of the Hambledon Deux-ans apple, hardly one entry was set out to advantage; whilst the Class for a "Collection of Packages suitable for the foregoing sorts of Fruit,"—which one might have supposed would have tempted tin-box, jar, punnett, and basket-makers to advertise their wares cheaply,—had not a single entry of any kind. Probably it will be best to allow the growers of soft fruit—raspberries and strawberries—to exhibit in 1lb.-baskets or glass jars. But fermentation, and damage from journeying, will always keep the prizes in these classes within the district in which the Show is held; unless the Society allows any growers (being *bonâ fide* growers) to exhibit their produce in a manufactured state. The peas sent were wofully old, and the potatoes greened by the sun; and, altogether, the very nice tent, appropriated to this display, was not encouraging except as indicating what a great deal the Society has yet to do in an increasingly important department. It does not seem desirable

to compete with cottage-gardeners' exhibitions: and to allow half-a-dozen pods, or half-a-dozen roots, or fruits to be accepted as a specimen; but the effect of heat and light will make the very best lots to go off before the close of the Show if any quantity be exhibited together, whilst the date of the Society's Meeting is too early to admit apples or pears of the year to be in abundance. Altogether it is plain both that the prize-list for this department will have to be thoroughly revised, and that probably a special local committee, knowing the growth of the district in which the Meeting of the year is held, will have to be called in to advise each year's schedule. As things were, the display at Reading only made evident how very rudimentary at present is the education of occupiers of land in the very necessary art of how to display to advantage the minor products of the farm.

Report of the Judges of Fruits and Vegetables.

We regret that the fruit and vegetable exhibition is very poor and altogether inferior; that we have had as much or more difficulty in awarding the prizes than had there been a keener competition and grander show. Many of the classes were not represented, others hardly so, with only one or two entries of inferior merit. We hope in the future the exhibition will be more generally known, the exhibits more numerous, and the competition more keen, as it ought to be, considering the very liberal prizes offered by the Society in encouragement of this particular industry. We hope the present exhibitors will not be discouraged, but in future will send in their exhibits so good and numerous as to be worthy of the Royal Agricultural Society of England.

William Chambers.
Henry Swann.

In taking leave of the Show it seems only right to state that the inevitable inconveniences—which arise from the presence of a large influx of hurried strangers—were never less oppressive than they were on this occasion. Necessaries of all kinds were forthcoming, upon fair terms; and neither, in site nor access, was there any falling away, from its own high standard, in the Exhibition of the Royal in 1882.

XXXIII.—*Quarterly Report of the Consulting Entomologist.* By Miss ELEANOR A. ORMEROD, Consulting Entomologist to the Society.

I BEG to report that since the beginning of May many applications have been sent regarding attacks of injurious insects.

Notes have been forwarded regarding attacks of asparagus-beetles (*Crioceris asparagi*) from his Grace the Duke of Bedford and others, and inquiries have been made as to the habits and means of prevention of hop aphis and cuckoo-fly, turnip-fly or flea-beetle,* crane-fly,† mustard-beetle,‡ willow-beetle,§ and wireworms (larvæ of various kinds of elaters or click-beetles), to which I have replied as fully as possible; and in cases where remedial means have not yet been recorded in this country, I have suggested treatment which has been found useful in Germany or America.

Inquiries have been sent in as to remedies for beet-fly,‖ and information given of the various kind of manure, as guano, soot, mineral superphosphate, nitrate of soda, &c., which have been found serviceable as stimulating applications to keep up the strength of the plants during the continuance of attack; also (where the plan can be carried out) that the second attack of fly may be much lessened by cutting off leaves or drawing young plants that are infested, taking care that these are removed and destroyed, in order that the grub may not leave them, and go into the earth for its change to the perfect fly.

Three species of insects injurious to crops have been reported (with nearly complete details), of which the histories had not previously been recorded.

The pea-weevil (*Sitona lineata*),¶ of which the first stages have been looked for unsuccessfully from the time of John Curtis, has been traced from its larval state up to development by Mr. Hart, of Park Farm, Kingsnorth, Kent, who gives the following information.

The maggots are somewhat under a quarter of an inch in length, white, with brown or ochrey head, furnished with strong jaws; legless, and much wrinkled; they were found feeding at the end of May on pea-roots. In some instances there were indications of their having eaten channels along the main roots, but for the most part the soft knobs, or gall-like growths commonly to be found on roots of peas (as well as of other leguminous plants), appeared to be their favourite food.

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* *Haltica (Phyllotreta) nemorum* and *H. undulata*. † *Tipula oleracea.*
‡ *Phædon Betulæ.* § *Phratora vitellinæ.*
‖ *Anthomyia (Chortophila) Betæ.* ¶ *Sitones lineatus*, Schönh.

When full fed, the larva forms an oval cell without any lining to it, about two inches below the surface of the ground in which it changes to the chrysalis state. This is white at first, with the undeveloped limbs folded beneath it, and is armed with two spines at the extremity of the somewhat truncate tail. The beetles (see Fig. 1, magnified), which began to appear from the chrysalids in the first week in July, are of the size given on the root, and are at first of a creamy white, with pitchy head and black eyes. When fully coloured, they are black, covered with silvery grey scales, and having three light stripes running along the back, behind the head (the *thorax*), and fine whitish lines alternating with darker ones along the wing-cases. The horns, shanks, and feet are red.

Fig. 1—Pea-weevil (*Sitona lineata*).

Larva, Chrysalis, and Beetle (natural size and magnified).

It appears that the pea-weevil does little mischief in its larval state, whilst feeding on the roots, compared to what it causes later on in its fully developed stage by feeding on the leaves, especially when the young plants are retarded in growth by bad weather or other unfavourable influences. It is almost impossible to destroy it on the plants, in consequence of the weevils dropping down as if they were dead at the approach of a footstep. It has been, however, noticed by Mr. Hart that where pea-weevils abound they will come up to the surface in great numbers immediately after the ground has been firmly pressed. In this way heavy rolling was found to do much good last year, and probably by taking the roller to and fro many of the weevils would be destroyed, and the use of the hoe afterwards helps to give a start to the young plants.

The pea-weevils live through the winter, and I have found that these hybernated specimens laid white roundish eggs in profusion in captivity, when taken off the plants in the spring. Therefore it may fairly be conjectured that the weevils then go down into the ground to deposit their eggs on the roots, where the grubs hatched from them are shortly afterwards to be found.

The history of the clover-root weevil (*Sitona puncticollis*) * has been traced by myself from specimens forwarded to me by Mr. Christy, of Boynton Hall, near Chelmsford, together with

* *Sitones puncticollis*, Schönh.

information regarding its habits. These weevils, in all the three stages of grub, chrysalis, and beetle, much resemble the foregoing, excepting in being about a third larger, and in the weevil having, besides the three light stripes along its back or apparent neck, some light spots or *points* between them, whence it takes its name of *puncticollis;* and instead of the lines on the wing-cases, from which the pea-weevil takes the name of *lineata*, the clover-root weevil has some dark interrupted streaks.

The larvæ were forwarded to me early in April; these turned to chrysalids in earth-cells from the later part of May onwards, and the first weevils from them appeared about June 10th. The changes took place later in their natural state; there the chrysalids were found in great numbers in the earth amongst the clover-roots, and by July 11 the weevils were plentiful on the field of clover from which my specimens had been sent.

These root-grubs appear to be far more destructive than those of the pea-weevil. On the 23rd of March they were found feeding on the tap-root of the clover, and sometimes at the smaller extremities; in some instances large holes had been eaten, and in all cases the injured part turned black. At the above date two or three or sometimes more grubs were to be found at the root of every clover-plant that was examined; by the 10th of April they were more numerous, and in no instance was a diseased plant found without a grub; but where the plant was totally dead, no grubs were to be found. The clover observed was a large field of twenty-four acres, of which twelve acres were in wheat and twelve in barley in the preceding year (1881), and it was noticed that the grubs were much more plentiful on the solid wheat-land than on the loose barley-land. Also it was observed that in another field of clover, where "the wheat had stood about" (for a month or more) in the previous August and September, that all through the spring the spots where the "traves" of wheat had stood were untouched, although the clover between was dying from attack.

This grub is sometimes known as the "White Maggot," and the characteristic of the attacked parts of the clover-root turning black has been observed elsewhere. Suitable weather for good growth, or such treatment and applications as may encourage this, and rolling where practicable, appear to be the only means known of at present to check the attack of these weevils.

I beg to acknowledge the kind assistance of Prof. Westwood in determining with certainty the species of these weevils, and other specimens submitted to him.

The third kind of injurious insect reported, of which the habits had not previously been made out, is the *Hylemyia coarctata*, a

small greyish two-winged fly, which sometimes causes much injury to the wheat-crop by means of its maggots feeding on the bulb of the young plant. It is mentioned by Mr. Creese, of Teddington, that the attack is observable early in March, or in mild seasons about the middle of February, at which time the maggot is so small as to be hardly perceptible; its place of feeding is just at the base of the stem, where it remains a short time, and then moves off to another plant, the injured plant sometimes decaying at the heart of the bulb.

The maggots are legless, whitish, and much like those of the blue-bottle fly in appearance. When full grown they are upwards of a quarter of an inch in length. The chrysalids or fly-cases are chestnut-brown. The female flies are pale grey, the males have the body between the wings grey, but lighter at the sides, with a faint stripe along the centre, and the abdomen, which is long, narrow, and flat, is ashy, with a faint line along the back.*

With regard to habits and amount of injury, it is mentioned by Mr. Creese that the wheat-bulb maggot is entirely absent some seasons, but is very destructive in about three years out of four; that it attacks plants on land that has been fallowed in the previous summer, but does not ever appear on land which has been ploughed for the first time in the autumn, also that it always leaves a belt of five or six yards near the hedge untouched. The damage is sometimes so complete as not to leave a healthy plant in a yard; and in 1881 the destruction he records by wheat-grub was at the rate of 15 bushels the acre in 50 acres of fallow wheat.

Injury apparently of a similar kind has been reported to me from various localities for several years, but the cause was not made out. In this case larvæ were placed in the hands of Mr. R. H. Meade, who reared and identified them; also, as he had doubts of the cabbage-root flies, which did much damage by their maggots to the crops in Scotland last year, being rightly considered the *Anthomyia brassicæ* or *A. radicum* (regarding the precise naming of which there is a good deal of difficulty), specimens of cabbage-root-eating maggots were recently forwarded to him, which in due course proved to be of the *Anthomyia floralis*, a fly very similar to *A. brassicæ* in appearance. During last year it was found that applications of lime, and of gas-lime, and also of ammoniacal liquor, were useful in case of attack; and in experiments as to the effects of manures published in the 'Transactions of the Zoological and Botanical Society of Vienna,' it is mentioned that whilst land manured

* For full description see list of Brit. *Anthomyiidæ*, 16 *Hylemyia*, by R. H. Meade. 'Entomologist's Monthly Mag.,' 1882.

with horse-dung and bone-dust suffered from attacks of cabbage-grub, land close by, manured with mineral superphosphate, escaped. I have therefore mentioned this in reply to correspondents.

I wish also to draw attention to the onion-fly laying its eggs much more at the base, or side of the bulb, rather than on the leaves, than is usually supposed. Acting on this, I have, both during the present and last summer, had onions experimentally earthed up at intervals, and by thus keeping the fly from laying where the eggs would develop have much diminished attack.

Apple-weevils (*Anthonomus pomorum*) have been reported as injurious in Kent and the Isle of Wight, and also to have done much harm in the district round Isleworth, by means of their small white maggots, which, hatching from an egg laid in the forming bud, destroy it by feeding within.

Fig. 2.—*Anthonomus pomorum* (Apple-weevil).

1. Weevil. 2. Chrysalis. 3. Larva (all natural size and magnified). 4. Injured Apple-bud.

As this weevil shelters during winter under rough bark or rubbish on or near the trees, and falls to the ground on being alarmed, also as the females rarely fly, I have advised keeping the bark in good condition, and the ground beneath free from rubbish, &c.; also shaking the boughs well in March, and throwing gas-lime, or whatever might be preferred, under the branches and round the trunk, to prevent the beetles crawling back again.

Apple-trees also suffered severely near Guildford from the caterpillars of the "winter moth," *Cheimatobia brumata*, and although in the case of injury to oak-foliage some of this was shown, by specimens forwarded by his Grace the Duke of Bedford, to be caused by the small green-and-grey leaf-roller moth—the *Tortrix viridana*—some appeared to be caused by the Cheimatobia, especially in the woods at Longleat. Attack from this cause may be guarded against, as the female winter-moths have abortive wings; consequently if, when they develop in November, anything which they cannot cross is thrown round the trees to be protected, they may thus be prevented crawling up the trunks to deposit their eggs on the branches, and in gardens and orchards, if not on a larger scale, much might be thus done to save the trees.

About forty Reports, giving much useful information re-

garding prevention and remedy for attack of wire-worm, have been sent in.

I also receive frequent applications as to the possibility of procuring information or giving instruction for practical agricultural purposes regarding the prevention of injurious insects, and I have given short notes on the points which appeared most wished for, but have not as yet been able to attend to this very important matter in any way as it deserves.

XXXIV.—*Additional Remarks on Laying down Land to Permanent Pasture.* By C. De Laune Faunce-De Laune, of Sharsted Court, Sittingbourne.

In an article in the last number of this Society's 'Journal,' "On Laying down Land to Permanent Pasture," I confined myself almost entirely to the one point of the seeds which I consider necessary to form the pasture. My object was to confine the attention of the reader to that which my experience had led me to consider the most important and most neglected aspect of this urgent question.

Although only a short time has elapsed since that article was published, the numerous communications since received on the subject induce me to add further details. I may here mention that in the Table of mixture of seeds for good or medium soils (page 261) the headings ought to have been the same as the headings in pages 262 and 263. The conclusion I had arrived at was that 41, 40, and 38 lbs. respectively were sufficient, assuming the seed to be of the indicated germinating power; if seed of a higher germinating power could be procured, less might be used, and if lower, more would be necessary.

I inadvertently used the wrong heading, and am glad that my attention has since been called to the mistake; and I take this opportunity of adding that I should advise in the mixture indicated an increase in the quantity of the foxtail, if early grass is considered of special value and equivalent to the greater cost of the seed.

Let me further correct a word which I overlooked in reading the proof of page 257. Fiorin should have been characterised as "perhaps the least known," but it was printed "best known."

I have already urged the importance of obtaining each kind of seed separately, and of having each parcel of seed examined before sowing. I may now add that, certain as my own ex-

perience had made me of this necessity, the communications I have received during the last three months have confirmed my opinion.

Mixtures of grasses for permanent pastures have been brought before the notice of the Seed Committee of the Royal Agricultural Society, and examined by Mr. Carruthers, which had been purchased as containing the kinds and proportions of seeds recommended by me in the Society's 'Journal,' and have been found to contain a large proportion of rye-grass, Yorkshire fog, and other worthless grasses.

Information, which Mr. Carruthers and myself believe to be authentic and trustworthy, has been obtained by me showing that the cultivation of easily-grown and very productive grasses of a worthless, and even injurious, character is carried on to an extent hardly to be credited, for the purpose of mixing with the seeds of the more important and more costly grasses, which, when thus mixed, are sold to the public.

It is a matter of surprise to me, as well as a matter of regret, that there are seed-merchants in London who are ready to buy the refuse cleanings of seeds separated by the larger seed-merchants which they would not sell to their own customers. These refuse cleanings, consisting of weeds and broken and imperfect seeds, must find their way into the farmer's fields at a serious loss to the farmer, not only in the money paid for them, but at a pecuniary loss still more serious by the damage to the land on which they are sown.

In my opinion, landowners and farmers are to blame in trusting to advertising firms without attempting themselves to acquire the knowledge requisite to enable them to discriminate between good and worthless seeds, or even to know, when the grasses come up, whether the seeds purchased were correct and of good quality. One result of this ignorance has been that some of the seed-merchants have not apparently been anxious to acquire a sufficient knowledge of the distinguishing characteristics of seeds and grasses, finding it more profitable to sell indiscriminately good and worthless kinds and inferior qualities.

I have been much surprised to find that men who have spent the greater part of their lives in the seed-trade are practically unacquainted with many of its details. I have not met one seed-merchant who was able to show me the difference in the seed between rye-grass and meadow fescue. The difference may be very minute, but, when once known, is quite clear.

A combination of ignorance and apathy on the part of the landowners and farmers has thus reacted on the seed-merchant, and, as a result, those firms who have wished to be honest and

have been desirous of gaining a knowledge of good seeds and grasses, have found themselves unable to compete with their less scrupulous brethren.

Again, reverting to rye-grass, experience this summer has confirmed my opinion as to the absolute necessity of excluding it from all orders for seeds for permanent pasture. I do not wish to say that there may not be some value in rye-grass which is not contained in some other grasses, although I have not perceived any; but, on the contrary, I believe it has been the cause of much mischief, yet, as it is upheld by great authorities on grasses, I might not contest the advisability of ordering 1 lb. or 2 lbs. per acre were it not that if any, however small quantity, is ordered, it at once opens the door to its being supplied in inordinate quantity mixed with other seeds; whilst, if none at all be ordered, it would be easy, when the grass comes up, to detect the quantity of rye-grass which may have been included by the seed-merchant.

My observations lead me to believe that rye-grass is detrimental to the formation of a new pasture, not only because it is a short-lived grass, but because, owing to the shortness of its roots, it exhausts the surface of the soil; and when it dies, the bare space left is so impoverished that, though grass seeds may germinate upon it, they will fail to live unless highly manured by accident or on purpose. Besides, the feeding qualities of rye-grass, as determined by chemical analysis, do not encourage its cultivation; and in my own experience it has proved, at some seasons of the year, injurious to the stock.

The difference between growing grass and making a pasture is great. The formation of a good pasture for thick turf must be the work of time; the length of time depends on a variety of circumstances, such as the amount of manure applied, the state the land is in, the climate, the quality of the seeds used, and the after-culture—all these being important elements.

If land is in good heart, and sown with good seed, a large quantity of grass is grown, but a thick compact mass of herbage is wanting. I have seen many very good meadows composed of a compact mass of herbage, but always containing a large proportion of weeds and worthless grass, and yet of great value; and the question to which, up to this time, I have no data on which to give an answer is, What will be the value of a meadow composed almost entirely of the best grasses, clovers, and herbs, when it has formed a thick turf and has accumulated in the soil that large stock of fertilising ingredients which Sir John Lawes says makes the establishment of a pasture so tedious and costly a process?

I have watched with care the formation of my new pastures,

and have come to the conclusion there are many agencies at work, and that it is a mistake to depend on any single agent.

Allowing that the land is of fair quality, clean, and in moderate condition, and sown with seeds such as I have recommended, when first fed off with sheep it will be noticed that the plants are more or less detached, but as the year advances they increase in size, and the clovers send out their creeping stems and gradually unite the grasses together.

It will also be noticed what an enormous amount of work is done by worms, as has been so clearly and ably demonstrated by Darwin. I have seen a worm-cast thrown over a plant of cocksfoot, which afterwards pushed out young stems on all sides; then a seed of crested dogstail fell into the worm-cast, and immediately the new plant grew there with the utmost vigour, finding all the nourishment it required from the worm-cast; it then pushed its roots through the cocksfoot, and rapidly the two became a compact mass. In the formation of pastures this process is again and again repeated with other grasses in different order, such as meadow fescue on foxtail, and foxtail on crested dogstail, until after a time the whole surface becomes one compact mass of herbage and roots, which protects the young shoots and the crowns of the plants from the treading of stock and from drought and cold, and leads to the desired end—a good turf. I always like to leave a certain percentage of good grasses to seed, as they fill up the bare spaces, and the stalks, if not eaten by stock, serve to enrich the soil and defend the young and tender plants during the first winter after germinating. I feed with artificial food of as high manurial value as I can, for the more rapidly the grasses grow the deeper the roots will penetrate and the more the plants will be able to withstand the vicissitudes of weather. If a piece of old pasture be soaked in water until the whole of the earth be removed, the nature of the turf, the formation of which I have tried here to explain, will be clearly demonstrated.

From what I have said, it will be apparent that the worm is a very valuable assistant to the farmer in forming a new pasture. There are, besides, aspects of the operations of worms on which I have not touched, but which are fully expounded in the work of the late Mr. Darwin. In it is an important question, which has not received the attention it deserves, whether some of the artificial manures we employ may not be destructive to this humble but important assistant?

The value of so-called weeds as ingredients in the food of stock, from a medicinal or any other point of view, is a subject demanding further and much more careful investigation than it has yet received. No doubt some of these plants are essential

elements in good pastures, though it would be dangerous to the health of the stock to allow them so to exceed their proper proportions as to compel the stock from hunger to eat them. I have, therefore, avoided recommending the introduction of any of these plants into pastures, with the exception of yarrow, which I still hold to be of great value. My own observations on other plants occasionally eaten by stock are not yet sufficiently extensive to justify my drawing conclusions; but I hope to continue them, and would be glad to receive communications from any who have made observations on this subject.

I trust that the experiments at Woburn and Rothamsted will in time be able to determine exactly the question of permanency in the clovers. I have formed an opinion for myself; but when I found eminent authorities differing on the subject, I preferred in my last article to recommend the four clovers to be sown in accordance with the seed-merchants' circulars;' and I may add that having used that quantity of those four clovers, I have not been dissatisfied with the results.

In my former article the estimate of the number of seeds in the lb. was taken from Sinclair in all cases in which he supplied the data; the number of seeds in each lb. given by other authorities differ from those of Sinclair, and also from examinations made on my own account. Although a knowledge of the correct number of seeds in each lb. is important, yet as I have calculated the lbs. per acre for each grass in accordance with Sinclair's basis, and have in practice found the results very satisfactory, the number of lbs. of each grass to be used per acre would remain the same, even though it should be established that Sinclair's calculations were not correct. And any such new calculations must be on an extensive scale, for one must bear in mind the great differences that are caused by the quality and size of the seeds.

I farm upwards of 900 acres, in which there is very good land, moderate land, poor chalky banks, and gravel; but no wet land. I have come to the conclusion, from my own experiments and the observations I have made in many parts of England, Scotland, and the Continent, that in laying down to pasture on all lands the selection should be made from the grasses I mentioned in my former article; and that, as on a violin all tunes must be played upon the limited number of strings in that instrument, so in laying down land to grass, all pastures ought to be formed of this limited number of grasses.

There can be little doubt that the country is gradually getting worn out: from our meadows having been ploughed up, from hay being continually removed from them, or from the continual production of milk. One great question of the day, in my opinion,

would be solved, if farmers would but learn that grasses, although they exhaust the land to the same extent, are of very different feeding values, some being almost worthless, and that grass-land is as capable of improvement when properly farmed, in the same ratio as, if not in a far greater ratio than, arable land. The practice which I have followed in laying down pasture, and which I have tried to urge on others, is diametrically opposed to the plan of leaving land to cover itself with pasture. No doubt in time a pasture could in this way be formed; but the elements of the pasture would be the grasses and weeds of the hedgerows and roadsides, and especially those whose seeds were smallest and lightest, and so easily carried to the vacant ground. If the farmer is an intelligent cultivator of the soil, and realises that different grasses have very different values, he could not be satisfied with such a method of "selection." The whole object of the practical farmer is to interfere with Nature's "selection" of seeds; and by the employment of the best varieties of grain, roots, fruit, hops, &c., to make the most of his farm. But is he to stop short here? And should his pastures not receive the same care in selection and cultivation as his other crops?

Nevertheless, this method has its advocates even amongst the ablest and most learned farmers of England. With a view of confirming my own opinion and convincing others, I have separated two portions of fields on which lucerne has been fed off; the stock on one portion having been very highly fed, and on the other but moderately. I have also a plot sown with good grass, and another unsown, but now covered with the so-called natural grasses, to which stock have not had access. All who have seen these plots are as strongly convinced of the necessity of sowing good seed as I myself am.

I wish especially to impress on my readers that the result of my experiments thus far has been that I have laid down to permanent pasture, without encountering the period of deterioration which has hitherto been the universal experience of farmers; but that, instead, my meadows have gone on from year to year improving and increasing in their productivity for breeding and fattening purposes.

XXXV.—*Report of the Senior Steward of Implements at Reading,* 1882. By Lord Vernon, of Sudbury Hall, Derby.

In looking back to the term of his service during four years, any Steward of Implements may well feel regret at the close of his labours.

If hard work and responsibility are often overwhelming, a Steward, in common with all the officials of the Society engaged in the work of a Show, has the certain knowledge that his humblest efforts are directed to the advancement of the largest industry of the country.

He can always rely on the goodwill of his colleagues, and on a general support from exhibitors in the maintenance of the rules of the Society, which it is his duty to see enforced without partiality or favour.

Each year of exhibition brings a new Steward on the scene, who views the operations of the Society from his own standpoint. Thus, little by little, a large proportion of the Council are enabled to gauge with some measure of exactitude the changes necessary in the arrangements of the Show to meet the ever altering conditions of agriculture.

My tenure of office was inaugurated by the Kilburn Show in 1879, great in its associations, both national and international, great in its area, great in its disasters. Ruinous as the financial results have been to the Society, there is every reason for believing that no agricultural exhibition has so deeply impressed the public mind with the resources of British agriculture and with the power of the Royal Agricultural Society to enlist them for the purpose of exhibition to the world.

At Kilburn, in 1879, at Carlisle, in 1880, and at Reading, in 1882, the rainfall prevented the attendance of visitors, leading to serious financial loss at each Show. At Derby, in 1881, the weather was all that could be desired; the attendance and receipts were consequently large.

It has been my privilege at various times to have been associated with the work of the Shows of the Society since 1860, when the Show was held at Canterbury, and when for the first time I acted as Steward of Implements.

The first Show of the Society was at Oxford in 1839. At the third, at Liverpool, in 1841, statistics were first collected, but these were comparatively meagre.

The Show at Canterbury may thus be said to have occupied an intermediate position between that at Liverpool, in 1841, and that at Reading, in 1882.

A comparison of the statistics of these three Shows may be

useful as indicating to some extent the progress and responsibilities of the Society. They are accordingly appended.

COMPARISON of the NUMBER of EXHIBITS at the SHOWS held at LIVERPOOL, CANTERBURY, and READING.

Year.	PLACE.	Number of Implements Exhibited.	Stock Exhibited.	Number of Persons Admitted.
1841	Liverpool	312	324	No return.
1860	Canterbury	3947	891	42,304
1882	Reading	6102	1467	82,943

ANALYSIS of EXHIBITS of STOCK at LIVERPOOL, CANTERBURY, and READING.

Year.	PLACE.	Number of Horses Exhibited.	Number of Cattle Exhibited.	Number of Sheep Exhibited.	Number of Pigs Exhibited.
1841	Liverpool	20	136	146	18
1860	Canterbury	112	288	371	119
1882	Reading	239	598	442	188

MONEY offered in STOCK PRIZES at LIVERPOOL, CANTERBURY, and READING.

Year.	PLACE.	Horses.	Cattle.	Sheep.	Pigs.
		£	£	£	£
1841	Liverpool	75	445	330	30
1860	Canterbury	325	890	570	180
1882	Reading	1395	1415	795	300

NUMBER of MEMBERS and INCOME of the SOCIETY in the YEARS 1841, 1860, and 1882.

Year.	PLACE.	Number of Members.	Receipts from Subscriptions, Compositions, and Dividends.
			£
1841	Liverpool	4595	6018
1860	Canterbury	5165	6717
1882	Reading	8080	6555*

* Receipts for 1881, the accounts for 1882 not yet having been completed.

These figures clearly show that during the first period of nineteen years there was a very small accession of Members to the roll of the Society, but that during the second period of twenty-two years the numbers have substantially increased. It must, however, be borne in mind that this body, large as it is, is small in proportion to the agricultural interest of England as a whole, while the small increase in the income from subscriptions as compared with the number of Members is to a large extent attributable to the fact that very few Governors are on the list of the Society at the present time, while a large number joined its ranks soon after its establishment.

That the numbers of Members should be so limited is all the more remarkable when the advantages offered to them for an annual subscription of 1*l.* are taken into account.

The direct advantages are :—

1. The admission to the Society's Shows.
2. Two numbers of the 'Journal.'
3. Privileges of chemical analysis.
4. Opinions on veterinary cases.
5. „ „ seeds and plants.
6. „ „ entomological subjects.
7. Power of entering animals for competition at the Society's Shows at nominal fees.

The indirect advantages arise from the benefits conferred on the agricultural classes through the investigations of the Society in the field of science, whereby new agricultural processes are first suggested, and afterwards brought in the experimental field to an economical test.

The laboratory researches of the Chemical Professor, whereby the adulteration of manures and feeding-stuffs has been detected and exposed ; the inquiries into the diseases of animals by the Veterinary Professors ; and the researches of the Botanical and Entomological Professors, can all be noted as benefits to the subscribers to the Society. They, however, involve an expenditure which increases rapidly year by year, making it difficult for the Council to satisfy the ever-increasing demands of the exhibitors for an enlargement of the prize-list.

Further, the perfecting of every agricultural implement now in general use, has resulted from the work of the Society.

Each implement in turn has been brought to the test of a trial at the various Shows since 1841.

The history of the trials of any one of the implements, large or small, whether of ploughs, horse-hoes, drills, steam-engines, threshers, hay- or corn-cutting machines, steam ploughs, cream-separators, and churns, is the same.

Brought to the Society with many imperfections, each imple-

ment is subjected to a trial before carefully chosen mechanical and agricultural experts; every point, favourable or unfavourable, being noted; and the prize of honour being finally awarded to that implement which, on a balance of points being struck, comes out the best. The prize is, however, withheld, whenever there is not a sufficient degree of merit to justify an award. In this manner the agricultural machinery of the country has been brought steadily and surely to its present state of perfection, to the benefit equally of the farmer and the exhibitor.

The farmer, wishing to ascertain which, in the opinion of the Society, are the best implements, can find a list of them in the prize-lists of previous years, or in the case of implements under trial, can see them in the trial-field, and so form his own conclusions as to their respective merits. He may, further, compare their constructional points in the Showyard, and finally read and digest the carefully considered Reports of the Judges who have tested the implements.

The exhibitor of an implement under trial has an opportunity afforded to him of observing the good and bad points of his implement, and of others competing with it, and of afterwards altering it in its parts, as far as he thinks it desirable to do so.

To gain the First Prize or Gold Medal of the Society, has been the height of the ambition of all exhibitors at the Shows, as is abundantly proved by the eagerness with which these honours are sought after, and when obtained, made known to the public as widely as possible.

To ensure accuracy of result, the Society entrusts the conduct of the trials to men whose honour, intelligence, and practical knowledge give special weight to their decisions. Those who have watched the work of the Judges in the trial-fields, continued uninterruptedly, often for many weeks, in bad and good weather alike, can bear testimony to the fidelity with which they perform the responsible duties allotted to them.

But fidelity and energy on the part of the Judges are not sufficient. The object of the Society is to give *reliable* opinions.

In order to test with accuracy the merits of each implement, very delicate dynamometrical tests are indispensable. For this purpose the Society has from time to time, as occasion required, provided at great expense dynamometers and other mechanical appliances made under the advice and direction of their eminent Consulting Engineer.

The collection of this testing machinery was brought together at Reading for inspection by a Committee appointed for that purpose. It is worthy of consideration whether this valuable collection, if exhibited, would not furnish an additional interest at future Shows. I venture to express an earnest hope that, in

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view of future trials, it may not be dispersed, but be carefully preserved.

In taking leave of my office, I beg to offer a few concluding remarks with reference to the Reading Show.

To the Judges of the Hay-Dryers and Miscellaneous Articles respectively, I shall leave the duty of making their own Report. It belongs, however, to my province to express my high sense of the value to the Society of their services.

If I particularise the Judges of the Hay-Dryers it is because their duties extended over a period of several weeks, and being connected with a subject entirely new, demanded an attention to the preliminaries of trial which was somewhat unusual. All I can say is, that it is fortunate that so important a trial has been entrusted to Judges of such eminence, whose Report will be read with confidence by all who know them.

Under the head of Miscellaneous Articles, the Trials in the Society's Working Dairy are included. The development of the Dairy productions in the country is an object well worthy of the attention which the Society has now for some years devoted to the subject. There does not appear to be any serious danger of competition from abroad for any articles of agricultural produce of first quality, and in no direction is this more the case than with regard to articles made in the dairy. The Society, having had this in view, incurred great expense in preparing for the trials of Cream Separators. Although there were ten entries, only four came to trial. Good reasons may have existed for their non-appearance, still the causes were not within the control of the Society, and the expense of preparation of a building for implements entered for trial which did not appear ought not, in my opinion, to be borne by the Society. Such a possibility should be guarded against at future Shows.

The Show-ground was all that could be desired, and much credit is due to the Local Committee for the care with which every preparation, both in the Showyard and elsewhere, was made for the Society. The Mayor and Corporation of Reading did all that collective and individual courtesy and hard work could accomplish to make the Meeting agreeable and useful. The inhabitants vied with them in their honourable reception of the Society.

If the weather did not altogether smile on us, there was universal sunshine everywhere but aloft.

In retiring from my office, I resign the Senior Stewardship into the far more efficient hands of Mr. Bowen Jones, my fellow-worker for three years, and I congratulate him in having as a colleague Lord Moreton, the most vigilant of Stewards, as he is one of the most rising agriculturists of the day.

XXXVI.—*Report on Cream-separators and Miscellaneous Implements at Reading*, 1882. By T. F. Jackson, Tattenhall Hall, Chester.

Rainy and unsettled weather has been associated with the Royal Agricultural Meeting so often, that I almost fear it may become proverbial; this year has certainly been no exception to the rule. There were all the conditions to hand at Reading this year for a most successful Meeting, fine weather being the only absent factor, and the elements conspired, "and nearly succeeded too," in frustrating the combined efforts of Council, Secretary, and Stewards. The ground on which the Show was held was admirably suited for such an exhibition, especially so in wet weather, the water quickly draining away through the porous soil. After the exceedingly wet day of Tuesday, the 11th of July, the ground on the following morning was comparatively dry; and under the directorship of Mr. Jacob Wilson, the Stewards were enabled to have the Show-ground in perfect order for the visit of his Royal Highness the Prince of Wales.

These natural advantages of ground, and the capital approaches thereto by road and rail, we hoped would have so much assisted implement-makers in setting up their stands, that we should find everything in order for the 3rd of July, the time appointed for all machinery being placed in the yard. I cannot speak too highly of the courtesy of these gentlemen, when found, but for three days the Judges were tramping hopelessly through stand after stand without finding the principal, and in most cases without even a responsible person in charge. The consequence was that, when our duties ought to have been ended, we were hunted from one end of the yard to the other by exhibitors who unceasingly cried out that some boon to the agriculturists had not been brought before them (the public) through the medium of the 'Journal of the Royal Agricultural Society,' the fact being that when the Judges looked through the exhibits, these particular machines were reposing serenely in straw and packing-cases. I would ask exhibitors in future to leave at least one responsible person in charge of their stands until after the Judges have been round; this would materially lighten their labours.

The Royal Agricultural Society, recognising the growing importance of dairy farming in England, have done all in their power to stimulate it, by establishing a Working Dairy at their Shows, where the best machinery for dairy work has been tested. By these means they have enabled the manufacturer to turn out the best article at the lowest possible price, and so to combat the ever-increasing foreign competition.

This year the Council decided to offer two Gold Medals for competition at the Reading Show for the best Cream Separators, mechanical and horse-power. There were originally ten machines entered for competition; but owing, I believe, to an action pending for infringement of patent, only two makers came to the Show, exhibiting four machines in all, and these of only two distinct principles. The Judges gave these two exhibitors two thorough and exhaustive trials, and decided to award the Gold Medal to the Laval Separator exhibited by Messrs. Hald and Co., 24, Great Winchester Street, London, an exceedingly effective machine, being simple in mechanism, requiring little regulation or attention when working; it is easily cleaned, and leaves very little milk to be churned when stopped. The cream from this Separator is of excellent quality and consistency, and not half churned into butter as from some machines. The separation takes place best when the milk is from 80° to 90°, "about the heat at which the milk comes direct from the cow," therefore it requires no cooling, which is a great consideration. The only thing to prevent this extremely useful invention finding its way into every dairy, except perhaps the very smallest, is the price; and I shall be greatly disappointed if shortly we do not see such machines placed before the public in a very much cheaper form. By the aid of this Separator, in one hour or less from the time of milking, butter of the best quality, made from the purest sweet cream, can be delivered on the railway *en route* to the consumer. The product remaining is the skimmed or separated milk, a most wholesome and palatable product, for which a ready sale should be found at 4*d.* per gallon, or it could be made into cheese in its simple form, or lard added and "bosch cheese" (as some gentlemen were pleased to call it at the General Meeting of the Society), manufactured. This kind of cheese is very largely made in America, and sold in England at a cheap rate; it forms a wholesome article of food, and I can see no reason why it should not be sold, always providing it is sold for what it is, and not to prejudice by its cheapness genuine whole-milk cheese.

The following instructions respecting the trials of Cream Separators were issued:

1. There are three exhibitors and ten entries, all of which must be in working order by 9 A.M., on Monday, July 3rd.

2. The exhibitors are to declare the speed at which their machines are to be run. The power to drive them will be ascertained by means of a dynamometer at the speed stated, the machines being worked with skim-milk or water.

3. The engineers are to satisfy themselves that the machines are really speeded to the proper extent, and they will take such

precautions as may be necessary to prevent the occurrence of accidents likely to arise from the high speed at which the machines are driven.

4. The duration of each trial is to be an hour.

5. All the Separators are to be supplied from a vat common to all. This vat will be raised to a sufficient height to command the Separators, and a pipe furnished with a stop-cock will be led from the mixing-trough connected with the vat to each machine.

6. The Separators in each class will be tested simultaneously.

7. The Separators will all be worked by the same shaft, the speed of which will be kept as nearly as possible at 150 revolutions per minute, the exact speed being indicated by a speed indicator, and duly noted at regular intervals during the trial. The shaft will be 2 inches in diameter.

8. The milk will not necessarily be of one day's milking, but it must be sweet and good. The vat will have a double bottom supplied with steam, and the milk will be heated to such a point that it will reach the separators at 95° Fahr. as nearly as may be.

9. The skim-milk and the cream delivered by the machines will be weighed separately.

10. The Chemist to the Royal Agricultural Society will analyse the skim-milk from each machine, and for this purpose he will take such samples as he may deem necessary.

11. The Separators in each class will all start at the same time. The Judges will note the time that elapses in each machine between the time of starting and the time when complete separation commences to take place. The imperfectly separated milk will be put back into the supply vat of each machine. The rate of working at intervals, during the run, will be ascertained by noting the time in which a given measure is filled. All the machines will cease working on fresh milk at the same time, and the time required to finish their charges will be noted.

12. The rate of separation will be calculated from the quantity of milk treated (ascertained by the quantity of cream and skim-milk delivered) from the time when complete separation takes place to the time of simultaneous stopping of the milk supply.

13. The cylinders of the machines are to be examined at the conclusion of the trials to ascertain how much milk remains in them.

14. If any machine leaves more than ·4 per cent. of butter-fat in the skim-milk, it will be considered out of the competition.

15. **The following are the points of merit determined for the guidance of the Judges:—**

Power required to work Separator .. .. Quantity of milk per hour hour dealt with .. .. Price of machine	30
Lowness of speed	10
Completeness of separation as determined by analysis and general efficiency (*e.g.*, 11 and 13)	30
Simplicity of construction	15
Power of adjustment for varying percentage of separation	15
	100

16. **The following will, as far as practicable, be the order of trial:—**

Monday, July 3rd.—Preliminary runs with water by exhibitors, to enable everything to be got into perfect working order.

Tuesday, July 4th.—Trial of horse- and manual-power machines.

Wednesday, July 5th.—Trial of steam-power machines.

Thursday, July 6th.—Final trials of machines, if considered necessary.

ONE HOUR'S TRIAL.

	Time Milk commenced to flow.	Time Cream commenced to flow.	Quantity of Milk passed through Machine.	Quantity of Cream.	Quantity of Butter.	Quantity of Milk left in Machine at the close of Trial.	Time occupied in Clearing Machine.
	Min.	Min.	cwts. qrs. lbs.	cwts. qrs. lbs.	lbs.	cwts. qrs. lbs.	min.
Laval's ..	3	3	4 3 10½	0 1 6	21	0 0 12¼	13
Hamburg:							
A side ..	4½	7	6 1 17¾	0 1 20¼	19¼	1 2 5	26
B side ..	3	5	8 0 12	0 1 24½	20½	1 2 11	21

TWO HOURS' TRIAL.

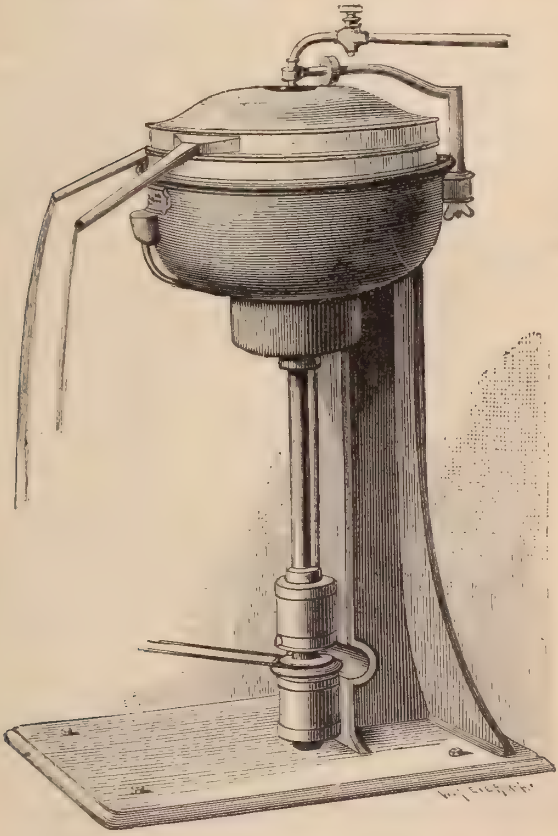
	Time Milk commenced to flow.	Time Cream commenced to flow.	Quantity of Milk passed through Machine.	Quantity of Cream.	Quantity of Butter.	Quantity of Milk left in Machine at the close of Trial.	Time occupied in Clearing Machine.
Laval's ..	2	2	8 2 18	0 2 5½	34¾	0 0 12¼	13
Hamburg Machine:							
A side ..	4½	7	11 2 3¾	2 2 8 *	44¼	*	26
B side ..	4½	7	10 2 21¾	2 1 18½*	47¾	*	26

* In this trial the milk left in the machine was weighed as cream, the machinists requesting it.

As will be seen from the above table, all the machines were run first for one hour, "cold water having been previously passed through the Separator to ensure everything being in proper order before the trial commenced": in the first trial 4 cwt. 3 qrs. 10½ lbs. of milk, or about 53 gallons, was passed through the Laval machine, and the cream, which was churned in one of Messrs. Thomas and Taylor's churns, produced 21 lbs. of butter, weighed after passing through a butter-worker.

Samples of the separated milk were taken during the run, one in half an hour from the commencement, and one just before the close of the trial; these were afterwards analysed by Dr. Voelcker, giving in the first instance ·29, and in the second ·20 of fat left in the milk.

Fig. 1.—*External View of Laval's Improved Cream Separator.*



The second trial was on July the 7th, and a two hours' run was given to each machine; the Laval passing 8 cwt. 2 qrs. 18 lbs. of milk through it, or 97 gallons, producing $34\frac{3}{4}$ lbs. of butter; the separated milk, by analysis, showing in three different periods of trial, viz. ·38, ·21, ·35.

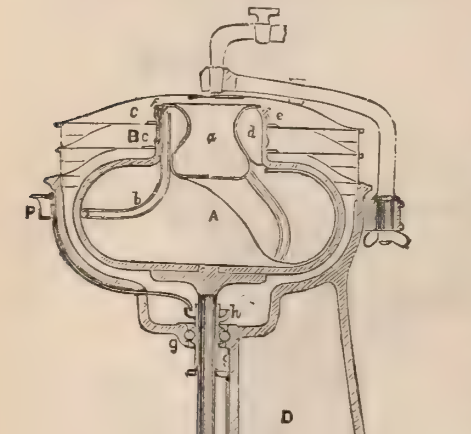
Below are a detailed description and drawing.

The milk as it comes from the cow is placed in a can, and delivered, by means of an ordinary tap into the funnel *a*, and through the small tube connected with the funnel, into the

rotating vessel A, which runs at a velocity of 6000 or 7000 revolutions per minute.

To the bottom of the funnel is soldered a thin wing, which forces the milk to follow the rotation of the vessel.

Fig. 2.—*Section of Laval's Improved Cream Separator.*



As soon as the milk enters the rotating vessel the separation commences; and during our trial the cream and skimmed milk commenced to *flow* in three minutes from the time of turning on the milk. The heavier portion of the milk is thrown towards the circumference of the vessel, and forced up the bent tube *b*, whence it is delivered through the aperture *c* into the lower of two tin trays, or covers, B, which is provided with an outlet-pipe. The cream, being the lighter, remains nearer the centre, rises round the outside of the funnel *a*, and through a small hole in the cylindrical upper part of the bowl; it delivers itself at *e* into the upper cover C, whence it is discharged through an outlet-pipe, a little more than a gallon of milk only remaining in this machine when stopped; and in thirteen minutes it was thoroughly cleansed and ready again for use. The power required to work this machine was taken by Mr. Anderson on the dynamometer, and registered as $\frac{2}{10}$ths of a horse-power. Price 37*l*.

The other Separators entered for trial were the *Hamburg Centrifugal*, patented by Heinr. Petersen. There was a large double-drummed machine, and a double-drummed smaller machine;

also a single machine,—all to be driven by power. The larger one was stated to be capable of separating 200 gallons per hour. In the trial it did not run nearly up to this capacity, as will be seen from the results given below. These machines,

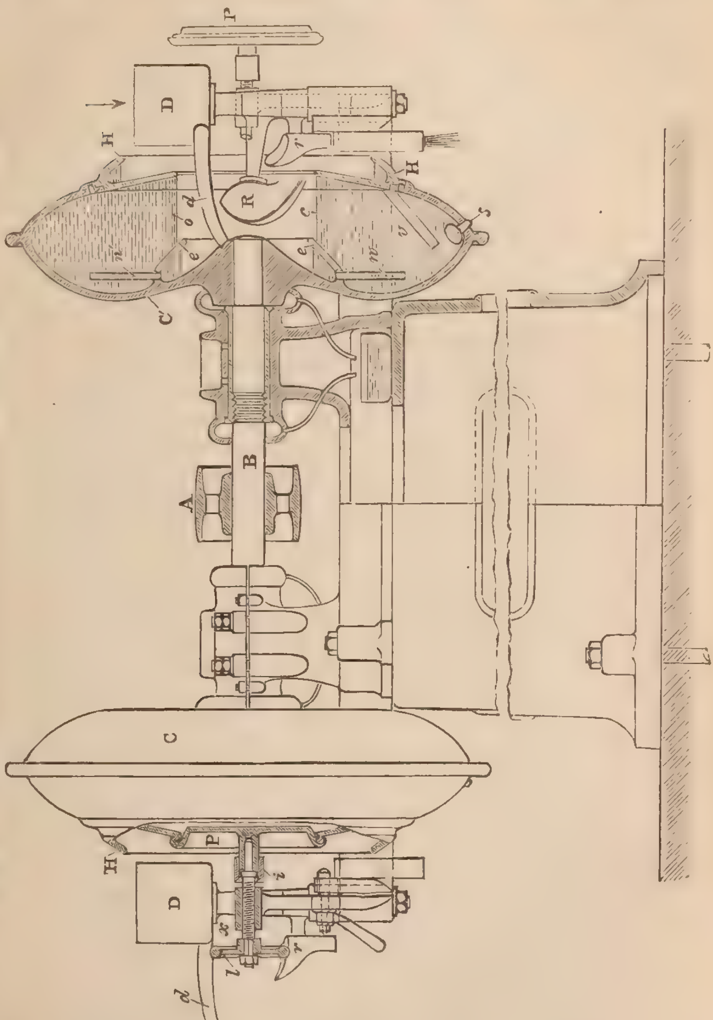


Fig. 3.—*Sectional View of the "Petersen" Centrifugal Cream Separator.*

unlike the Lavals, skim the milk and cream with a skimmer-cutter, very similar to wood-turning in a lathe.

Fig. 3 shows the machine longitudinally, and in working order, with skimmers placed in position, the right-hand half of the machine being shown in section. On the axle

is a pulley-wheel, A, for driving the two drums, which are firmly attached on the extremes of the axle B. The unskimmed milk is introduced into the machine, by filling a funnel D through a tube *d*, into its respective drum, firstly into the ring *e*, fastened to the inner nave wall, out of which it is thrown through the ends of the tube separators *n n*, towards the inside of the drum. In the drum the separation of the cream and skim-milk takes place by means of centrifugal force, the former gathering towards the upper part, *o*. When the separation of the cream from the milk has commenced, the cream-cutter R has to be fixed in position, as shown on the right side of the machine. By continual feeding, the revolving cream *o*, will be lifted to the skimmer R, and flow into a vessel underneath. The separated milk is then forced by continual pressure of milk inside, through the tube *b* into the hollow ring H, which is fitted on the front of the drum, from which it is skimmed by the cutter *r*, and runs into a vessel underneath. The quantity of milk passed through this machine in the hour trial was as follows: *a* side of machine, 6 cwt. 1 qr. 17 lbs., or about 70 gallons (this includes 1 cwt. 2 qrs. 5 lbs., or 17 gallons left in the machine, which under ordinary circumstances would have to be churned); the cream was churned and produced 19¼ lbs. of butter. The milk passing through the B side of the machine, including 1 cwt. 2 qrs. 11 lbs. left in the machine, was 8 cwt. 12 lbs., the quantity of butter produced was 20½ lbs. The percentage of fat in the separated milk, after half an hour's running, was, on the A side of the machine ·26, and on the B side ·41. The discrepancy in the results of the machine was caused, in the opinion of the Judges, by the arrangement of the skimmers and the regulating of the feed. It was noted that this machine required very careful attention and regulating, one attendant standing on each side, and constantly altering the feed. It will be seen that there was a very large quantity of milk left in this machine, that would have to be churned. The smaller double-drummed machine had the misfortune to get a part of the casting broken during transit, and the Judges thought it unfair to give the results of the trial in its mutilated state. Price of the large machine, 250*l*.

Perhaps the table opposite will more concisely show the results of the two trials.

The Reading Iron Works Company exhibited, and obtained the Society's Silver Medal for, a Machine for washing Railway Milk Cans. The machine consists of a strong wooden tank, 6 feet long by 3 feet wide. At one end of this tank are three revolving bristle brushes, taper-shaped to fit the can, driven by mechanical or horse-power, at 140 revolutions per minute. Two men, by the aid of this machine, can wash 200 cans per hour.

TABLE showing RESULTS of TRIAL of CREAM-SEPARATORS, following in order of the INSTRUCTIONS to the JUDGES.

LAVAL MACHINE.

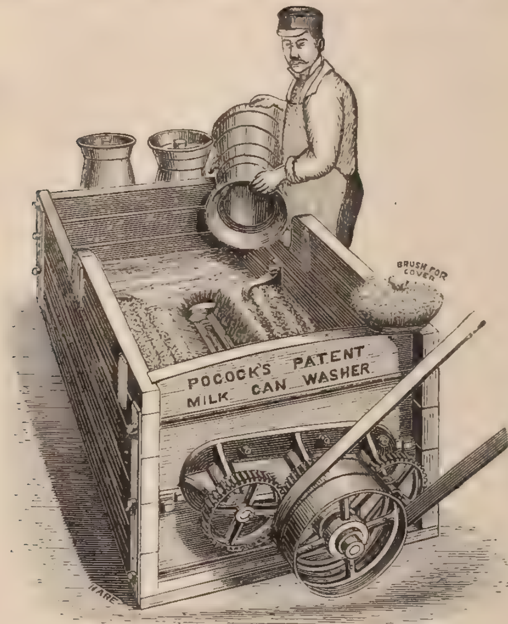
Power required to work Machine.	Quantity of Milk per Hour dealt with in Gallons.	Price of Machine.	Lowness of Speed Revolutions per Minute.	Completeness of Separation as determined by Analysis.	Simplicity of Construction.	Power of Adjustment for varying percentage of Cream.	
Two-tenths Horse-power	53 Average . .	£32	6000 to 7000	·24 Average	Very Simple	Very simple, by adjustable screw and regulating the feed.	
10	10	5	10	25	15	15	Total Points. 90

HAMBURG MACHINE.

Power required to work Machine.	Quantity of Milk per Hour dealt with in Gallons.	Price of Machine.	Lowness of Speed Revolutions per Minute.	Completeness of Separation as determined by Analysis.	Simplicity of Construction.	Power of Adjustment for varying percentage of Cream.	
Nine-tenths Horse-power	Large double Machine 80 gallons Average.	£250	6000 to 7000 revolutions per Minute	Average during Trials ·32	This machine is rather complicated.	Regulated entirely by the feed.	
10	5	. .	10	15	5	5	Total Points 50

There is a contrivance for throwing the two outside brushes out of gear, and by attaching a small circular brush to the end of the remaining brush, the lids are cleaned. The Judges besmeared two tankards with a mixture of paint and grease, well

Fig. 4.—*View of Pocock's Patent Milk-can Washer.*

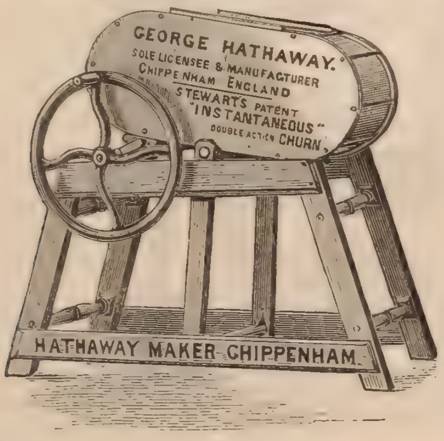


rubbed into the corners, and in the short space of a minute the can was perfectly clean. This machine would be useful for large dairymen, or for farmers to combine and have fixed up at some station or depôt, where their cans could be cleaned at a nominal cost, instead of, as at present, getting them returned in a foul condition. Price 38*l.*

Mr. Geo. Hathaway, of Chippenham, obtained the Society's Silver Medal for a Double Oscillating Churn. Its simplicity of construction and absence of any kind of dasher, together with the facility with which it can be cleaned, and its general efficiency, are justly claimed as advantages over most churns; its motion is most novel and effective. As a trial, Mr. Hathaway was supplied with 18 lbs. of cream, and in thirty-eight minutes the butter, of excellent quality, was ready washed in a solid lump, and placed direct under a butter-worker, without it losing any appreciable weight. The churn itself, as will be seen from the accompanying engraving, is an oblong box very much like the American swing churn; with this difference, that it is

balanced on a movable swing-axle in the centre. At the one end is attached a crank and wheel, which give it a tilting motion when the handle is turned, causing the cream to be thrown in two waves to the centre of the churn, the cream describing a figure ∞. The butter is produced by concussion, instead of by friction. Price 3*l*.

Fig. 5.—*View of Hathaway's Double Oscillating Churn.*

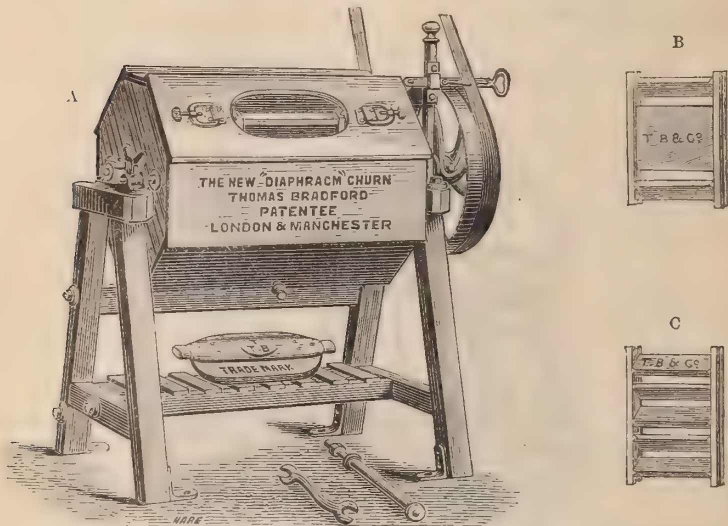


Messrs. Thos. Bradford & Co. also exhibited for the first time their Diaphragm Churn (Fig. 6, p. 626); it was tried with three gallons of cream, which it churned in 33 minutes. This is a revolving churn, working on roller-axles. There are two fixed dashers at each end of the churn, and a movable one that is slipped into the centre; Messrs. Bradford & Co. provide two of these dashers, one for cream, and the other for milk, the latter one being more ladder-shaped to give the milk more friction. The removing this dasher, without drawing out some of the butter with it, involves some trouble, and it must necessarily be removed before the butter is taken out. The butter from this churn was not so firm in texture as that from the oscillating churn.

Before closing this description of the Dairy machinery, the Judges would commend the stands of the *Dairy Supply Company*, and the *Aylesbury Dairy Company*, where every requisite for the manufacture of either butter or cheese could be seen; and during the whole Show there were daily explanatory exhibitions of the different methods of butter-making. The Dairy Supply Company exhibited a most ingenious Butter-printer, that prints on four sides; by compressing a lever at the will of the

operator, the four sides fall down and leave the print perfect. The Aylesbury Dairy Company exhibited the Lactobutyrometer, for testing the amount of fat or cream contained in

Fig. 6.—*Bradford & Co's Diaphragm Churn.*



A. View. B. Dasher for Cream. C. Dasher for Milk.

milk. This is a simple yet at the same time an expeditious and reliable test, that can be used by any one not possessing any scientific knowledge. *Messrs. Vipan and Headley*, Leicester, exhibited a number of agricultural machines, also a particularly substantial and well-designed Railway Milk Churn, made of steel in one plate, with only one seam, and coated with tin. The top of the churn is so arranged that any dust or dirt accumulated during transit does not fall into the milk, when the lid is hurriedly taken off, or washed by rain. The arrangement of the lid is such that any milk displaced during transit is thrown back into the churn, instead of washing up the sides of the lid and ventilator. The fastening can either be used with or without a lock. The bottom of the churn is stamped by machinery, and driven into position, rendering it nearly impossible for the rim or hoop to be knocked off; the fastenings are out of the way, and cannot be injured when churns are placed on each other; neither are there any projections to knock off when the can is tilted to drain. The handle is riveted to an independent plate, and soldered on the can.

In reporting on the other miscellaneous exhibits of the Show,

I will commence with the Machinery in Motion. There were several Compound Engines exhibited, both portable and stationary. *The Reading Iron Works* exhibited a Compound High- and Low-pressure as well as Condensing Engine, which was turned out in a highly finished manner; and our Consulting Engineer, Mr. Anderson, seemed very pleased with the construction generally, believing that the arrangement would economise fuel. Amongst the other exhibits of Compound Engines we had the best opportunity of examining one of *Messrs. Ruston, Proctor, and Co.* Not that we would set this engine up as the best of its kind, for without a competitive trial it would be most unjust to other exhibitors, but perhaps the Society, recognising this new feature in engineering, may shortly arrange for a trial, so as to bring out authoritatively the merits of the compound class. This engine has a high-pressure cylinder, 7 in. in diameter, and a low-pressure cylinder of 11 in. diameter, both having 14-in. stroke, placed side by side. The high-pressure cylinder has a cut-off valve regulated by the governor, so that steam could be cut off at $\frac{5}{8}$ths of the stroke. The boiler is of steel, working at a pressure of 120 lbs. per square inch. This engine weighs 113 cwt., while the ordinary twelve-horse-power double cylinder weighs 114. These figures are interesting, because they show that a compound portable engine can be made lighter than one of the ordinary type. The makers stated that, when tried on the break, the engine developed 30·26-horse-power; consuming 2·63 lbs. of Welsh coal per break horse-power per hour, and using only 20·46 lbs. of steam per break horse-power per hour. These results are wonderfully good.

Mr. Geo. R. Mather, of Wellingboro', showed a novel three-horse-power Portable Engine; the driving-wheels of which are also used for the carriage-wheels. When fixed for working, the shafts are tilted up, allowing the boiler to rest on its end, and the travelling-wheels are then keyed on to the crank-axle, the two wheels acting as fly-wheels. Mr. Mather has utilised Joy's patent steam-valve, and also one of Mr. Ramsbottom's patents, whereby he saves three glands, which is a consideration.

The Society's Silver Medal was awarded to *Messrs. Nalder and Nalder*, of Wantage, for their Single-crank Shaft Threshing-machine; the shakers, shog-board, and large riddle being all driven from one crank-axle, placed nearly centrally between the shakers. The ends of the shakers are attached direct to the shog-board and large riddle, at opposite ends, by flexible joints, made with india-rubber, which appear of great service. This arrangement dispenses with the riddle crank-shaft, bearings, connecting-rods, pulleys, and belt, and very considerably simplifies the

machine. From the accompanying drawing it will be seen that the shaker-boxes themselves act as connecting-rods for driving the shoes, by means of the one shaft-crank, placed nearly centrally, *H*. There are five of these shaker-boxes, three of which, *A*, are fixed at the bottom end in flexible joints, *E*, attached to the lower shoe, *E D*, the ends on the other side of the crank being free; the other two shakers are also fixed in flexible joints; but

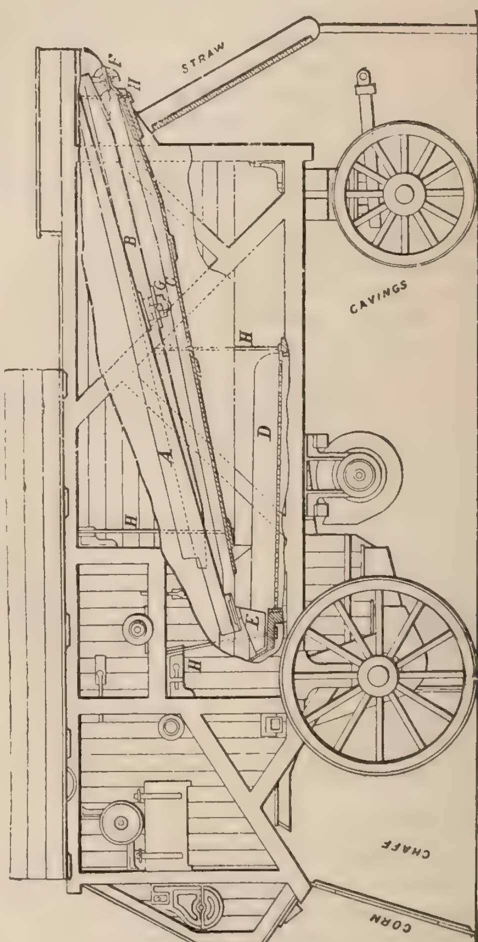


Fig. 7.—*View and Part Section of Messrs. Nalder & Nalder's Single-crank Shaft Threshing Machine.*

at the opposite end, at *F*, attached to the upper shoe, *C*, and free at the lower ends. It may be seen from this that each revolution of the crank gives the usual motion to the shakers, and also a

reciprocal motion to each of the shoes, which are suspended by the spring hangers. This machine was tried, to see the practical effect when working; the Judges especially noting whether the shakers lost any of their motion or effectiveness by this arrangement, and also testing the power of the riddles. The work done was quite satisfactory. The price of this machine is 142*l.*

Messrs. Gibbons and Robinson, of Wantage, Berks, also exhibited for the first time an improved arrangement for cleaning and making a better sample of tail corn, as applied to their Threshing-machine. There is very undoubted merit in this arrangement, and the Judges regret that they were unable to test it with unthreshed corn requiring a good deal of cleaning, Messrs. Gibbons and Robinson being only able to provide a very fine sample of wheat, nearly all the corn in the neighbourhood having been threshed before this season of the year. The chief merit claimed is a suction-fan, attached to the open wire barley-horner, to draw away the dust "through the perforated end of the barley-horner," that had not been previously taken out by the large fan before going on to the small riddle and blast-fan. There is also another ingenious arrangement for distributing the wheat or corn evenly over the riddle; instead of it falling in one mass, thereby exposing it to a greater force of wind, the current is delivered over the large riddle. By this arrangement all the corn blown over falls on the riddle, and is worked through the machine again in the ordinary course.

The usual number of Reaping and Mowing-machines were again exhibited, but nothing was specially brought out beyond *Mr. W. A. Wood's Two-horse Manual-reaper*, which has an entirely new frame and gearing-motion. The clutch and pinion-motion being used, the raising or depressing-lever is easily worked with the man on the seat without dismounting, and the machinery is very neatly covered. The same firm have improved the String-binding Reaper in the clasp and delivery, and also added an additional kicker for removing the sheaf. *Messrs. Kingsford and Fairless* exhibited an entirely new Sheaf-binder, to follow the reaper and to bind with string. Without a trial it is impossible to speak of its merits. *Messrs. Williams and Son*, Rhyl, have designed a new Steel Plate riveted to the cutter-bar of mowing-machines. It fits against the finger, and not to the finger, as is general. This is a very useful invention, and likely to prove advantageous.

The Bristol Waggon Company exhibited a new Cattle-van, on four wheels of equal size, the shafts being attached to either end of the van at will. By this arrangement the animal can walk straight through. The van is fitted with crank-axles, and is low

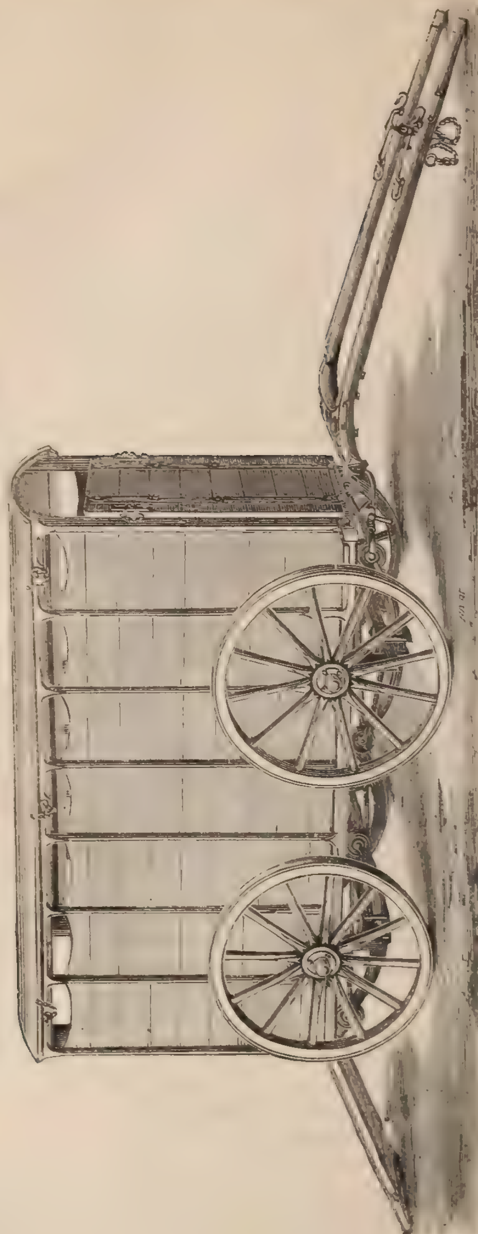


Fig. 8.—Bristol Waggon Company's Cattle Van.

to the ground. The wheels are comparatively large, and are locked simultaneously by cross-bars running transversely across to the axle. The springs are movable, a wheel being attached which works on the bottom of the van. This arrangement enables it to turn in a comparatively small space, and by the four wheels it maintains a much more even motion when travelling, and far easier for the horse or the cattle carried, especially in a hilly country. The price is 50*l.* The manufacturer assured the Judges that the cost price will be lowered.

Mr. C. G. Roberts, Haslemere, Surrey, exhibited an exceedingly ingenious apparatus for collecting pure Rain-water. The Judges were particularly pleased with this apparatus, and Mr. Roberts showed them its action with water from the ordinary main. Where water is scarce, and rain-water has to be stored, the apparatus would be very valuable; but without a lengthened trial extending over some months, the Judges considered that they would not be justified in awarding Mr. Roberts a medal.

The function of the Separator is to reject the bad and store the good water. It is self-acting, and prevents the first portion of the rainfall (which washes and brings down from the roof or gutters all kinds of impurities) passing into the storage-tank, by directing the water into the waste-pipe for a time; afterwards the Separator cants and turns the pure water into the storage-tank. An arrangement is made for it working quickly or slowly, to compensate for a heavy thunder-shower or a slow drizzling rain. The description in detail is as follows (see Figs. 9 and 10, p. 622):—A, removable strainer with perforated plate, to prevent rubbish passing into the Separator; B, outlet for water to pass into the Separator; C, Separator balanced on a pivot; D, small compartment into which the rain-water falls first; E, small hole, fitted with washer proportioned to the size of the roof; F, larger hole, to take the overflow-water from D during moderate rain; G, discharge-pipe. In a storm the water fills the compartment D, and flows over the top of this pipe; H is a small hole at the back of G, between the compartments. When the weight of water in I over-balances the Separator, it is canted (as shown in Fig. 10), and the pure water is directed by the sprout J into the storage-pipe K; L is a small hole at the bottom of the compartment I; M is the auxiliary pipe for keeping the compartment I full after the Separator is canted, when the rain is leaving off, so that the last rain may be stored; N is a hasp for holding it in position. The price of the Separator for a roof not exceeding 1200 feet area, is 2*l.* 10*s.* complete.

Figs. 9 and 10.—*View and Section of Mr. Roberts's Rain-water Separator.*

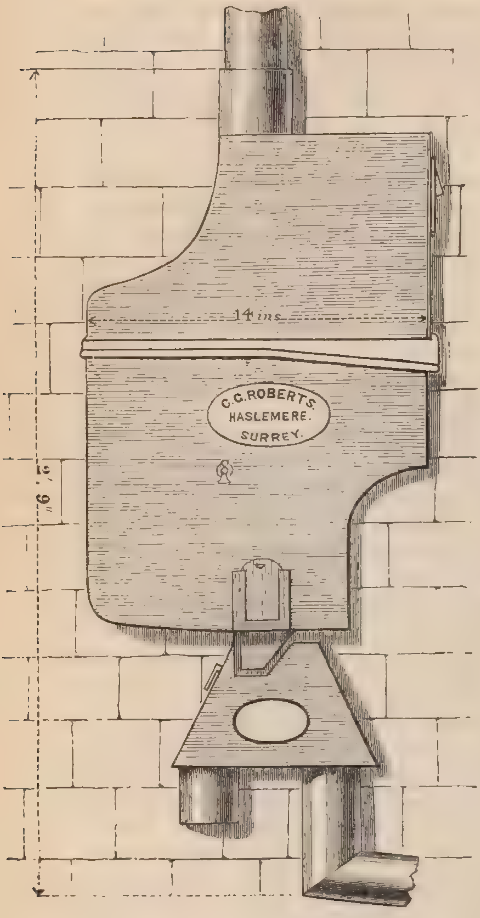


Fig. 9.—View.

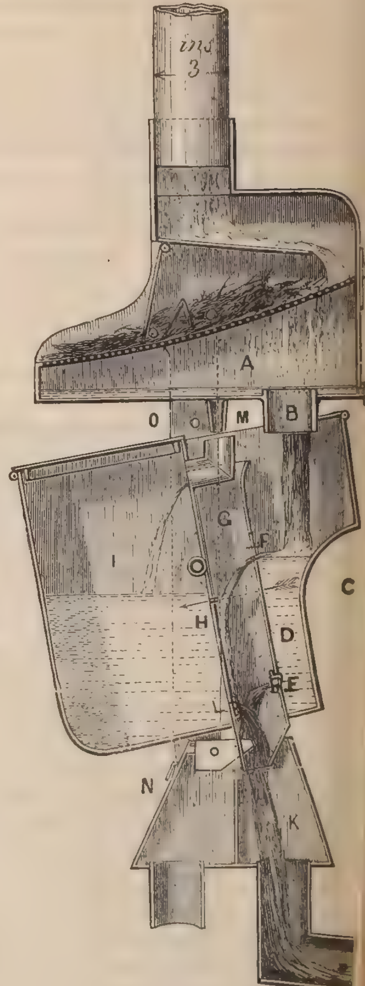


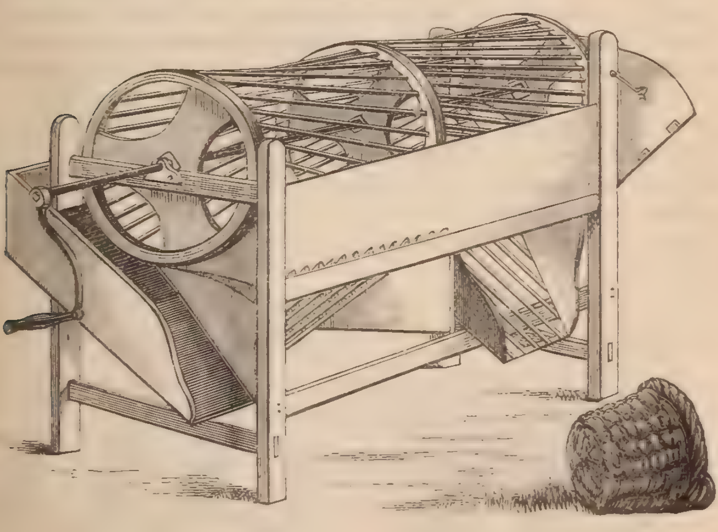
Fig. 10.—Section.

Messrs. Dening and Co., Chard, Somerset, exhibited a new Double-actioned Hay-maker, with two movable wings, which, extending beyond the wheels, increase the width of the machine from 6 feet to 9 feet 6 inches. The price is lower than that of many machines of the leading makers for a 6-feet machine. The Judges ordered this machine for trial into the meadow

where the hay-dryers were preparing for work. The crop was very heavy; and the wind at the time blowing half a gale gave the machine a severe test; and although the Judges could see considerable merit, they noticed some minor particulars that will be required to be altered, and, under these circumstances, they would not be justified in doing more than favourably mentioning the implement. In a moderate crop, with the back motion, the machine would be able to do a large amount of work.

The East Yorkshire Waggon Company offered to the public a new Potato Separator (Copeland's patent). By the aid of this machine three samples of potatoes are made with one operation. As shown in Fig. 11, the machine consists of a revolving cylinder made of round bars of iron, differing in width; the first compartment allows only the smallest potatoes to escape through, the second compartment taking the medium sized, and the best fall out at the opposite end. There is a wooden partition placed in the centre of the machine to prevent the potatoes coming through too rapidly. The motion is very slow, and the power required to work it very slight. The price is 6*l.* 10*s.*

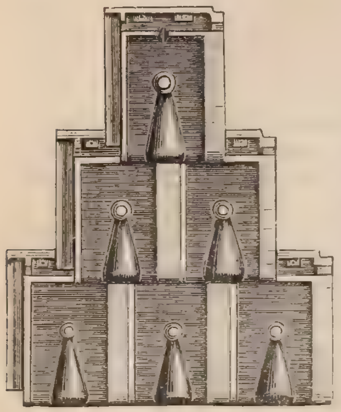
Fig. 11.—*View of the East Yorkshire Waggon Company's Potato Separator.*



Mr. C. D. Phillips, of Newport, Monmouthshire, exhibited a new roofing tile called the Lockjaw Tile, and designed espe-

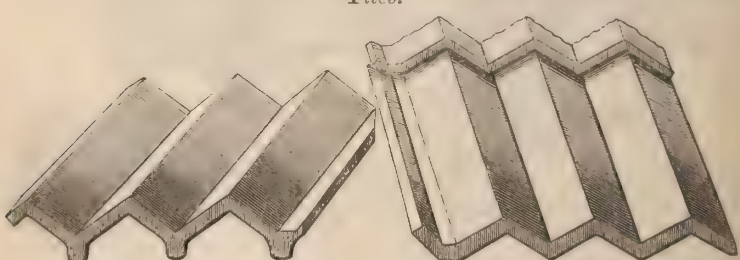
cially to prevent snow and rain from drifting through roofs; they are manufactured by power, which renders them less porous than the ordinary hand-made tile: they are so shaped that every individual tile dovetails into its neighbour and the joists of the roof at the same time, and is gripped by four fellow-tiles, thus rendering it less liable to be displaced by gales. If by any accident a tile becomes broken it is held in position, whilst a whole one can be substituted without much displacement of the roof. The lock on these tiles is ingenious, and forms a groove and tenon joint. They are ornamental in appearance, and low in price, rendering them adaptable for agricultural buildings or residences.

Fig. 12.—*Phillips's Lockjaw Tile.*



Messrs. H. J. and C. Major, of Bridgwater, also have brought out a new pattern of tile, designed especially to prevent drift of either snow or rain. These tiles are called "Angular Corrugated" roofing tiles. Each tile overlaps its fellow in the angle, and is clamped to the one above, materially assisting their mutual security, and fitting closely on to each other with the projection behind, an arrangement which would, I imagine, stop any drift. The sharp angles of the tile must assist the quick passage of rain from the roof. Messrs. Major exhibited very many kinds of roofing tiles, but the corrugated patterns recommend themselves.

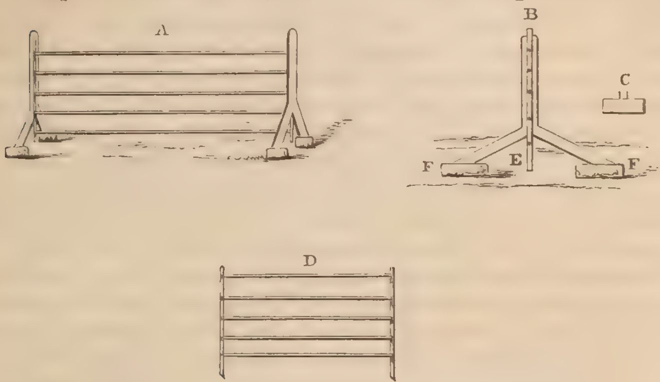
Fig. 13.—*Messrs. H. J. and C. Major's Angular Corrugated Roofing Tiles.*



Messrs. Doughty and Bradley, East Dereham, had some original exhibits that are quite a marvel of cheapness; but

there is a limit when cheapness is not economy, and some of the articles were lacking in detail of construction. Amongst the number, especially worthy of notice, was a very light and easily moved Sheep Hurdle, as will be seen by the accompanying drawings (Fig. 14).

Fig. 14.—*Messrs. Doughty and Bradley's Sheep Hurdles.*



A Is the hurdle in position ; B the sectional end of the upright, showing a groove for slipping in the hurdle D ; D is the plain hurdle lifted out of position for moving ; C is a small wooden foot for the upright. The hurdle is slipped into a groove riveted to the side of the upright B, which is riveted to, and rested on, an iron foot, E, with small wooden blocks at each end, F. This can be quickly removed by one man, and the hurdle being entirely plain, there is little danger of it bending or warping if it is thrown on the ground. The price is only about double that of ordinary wooden sheep-hurdles. The same firm have also a wooden SheepTrough, made without nails, and allowing the water to drain out at the bottom. The trough is screwed together with bent clips of iron running over the handle and screwing below the feet. The size of the trough is 9 feet long, 8 inches deep, 11 inches wide at the top and 5 inches wide at the bottom ; the price is 5*s.* 6*d.* each trough. Messrs. Doughty and Bradley have also invented a combined Corn Dressing Machine and Hay Drying Fan, being convertible either for suction or blast. The price of this combined machine is 7*l.* It is likely to prove a cheap and efficient machine for a small farmer.

Messrs. Proctor and Co., Stevenage, Banbury, Oxfordshire, claim as a new implement their Steam Digger. Messrs. Darby's Patent Digger has already been so lucidly explained in the Society's 'Journal,' that I will simply say that the work done by this digger is exactly the same, the difference between

the two machines being that, instead of the side locomotion as in Darby's Digger, Messrs. Proctor's tines are placed at the end, and follow the engine, and dig 12 ft. wide. The weight is very considerably lessened, and also the cost. The Digger exhibited at Reading was fixed to an ordinary 6-horse power engine, which could with little trouble be again detached and placed on its ordinary carriage if required. The price, without the engine, is 275*l*. The forks, three in number and 4 feet wide, are placed transversely, suspended from a strong frame, and actuated by three cranks on a rotating shaft, which is driven by an intermediate spur-gear from the engine crank-shafts above. The Digger makes 45 revolutions per minute, while the engine travels at the pace of 45 feet in the same time, so that each fork strikes the ground at an advance of one foot from the last stroke. This machine, with a man and a boy in attendance, is calculated to dig about seven acres in a day of ten hours. We did not see the machine working, so we are not in a position to pass an opinion on the quality of its work; neither is it our duty to draw a comparison upon the merits of digging as a means of cultivation over the old method of ploughing. We simply found the machine in the Showyard, and have very shortly described it.

Messrs. Coultas, of Grantham, exhibited a Blast-fan for drying corn when threshed. Their ordinary fan used for stack drying was attached to a large wooden receptacle, with a perforated bottom, and capable of holding four sacks of grain at once, through which the blast was forced. The Judges gave this machine a trial, by wetting four sacks of wheat on a tarpaulin, and left them soaking all night. The next day Mr. Coultas ran his fan for four hours; but when the wheat was again weighed, he had failed to take out all the added water.

Messrs. Jas. Walworth and Co., Bradford, Yorkshire, also exhibited a Grain Dryer for the first time. Owing to some delay in fitting the machine, he was unable to show it to the Judges at work, which they much regretted. The apparatus consisted of a long galvanised revolving cylinder, set on a slight incline, through which 15 steam-pipes were placed for heating purposes. An exhaust-fan was attached at the end for drawing off the damp steam arising from the drying corn. There was very considerable heat generated in this cylinder. Whether the steam heat would affect the germinating properties of the grain, or in any way injure it for milling purposes, we had no opportunity of judging. The cost of the machine is 90*l*.

Messrs. Benj. Reid and Co., of Aberdeen, offered their Force-feed Manure Distributor for trial. This machine is easily and quickly regulated, and will sow from 1 cwt. to 20 cwt. per acre,

or any intermediate quantity, and covers a breadth of 10 ft. When working, the feed is arranged by moving a slide over the chains that deliver the manure; the chains revolve over a cog-wheel, which prevents the links from clogging when damp manure is being distributed, while a revolving rake inside keeps the contents of the feed-box continually moving. The shafts are detachable, and are moved to the end of the machine, and the wheels to the centre of the Distributor for travelling purposes. The wheels are high, thereby lessening the draft to the horse. This is a most useful implement, although the principle is not new as applied to corn-drills; and under these circumstances the Judges felt that they would not be entitled to give it more than a favourable description. The same firm also exhibited a Root Extractor, an American invention, although comparatively new to this country. This is a double-lever arrangement, fixed on three upright legs for a fulcrum, with a locking arrangement to catch the chain as it is raised, and hold it in position. This Extractor would be most useful for reclaiming waste land, two men being able to put on a strain of 7 tons.

Messrs. Fred. and Horace Randell, N. Walsham, exhibited a number of new implements for the preparation of land for green crops. Amongst the number is a Drill constructed entirely of iron, and adapted for sowing ridges varying in width from 21 to 30 inches. This simple machine would apparently be very effective and durable. A cutter is attached to the leading rollers, and runs before the coulters, which doubtless is an advantage in preparing a fine seed-bed. The same firm exhibited a light and strong turnip-hoe.

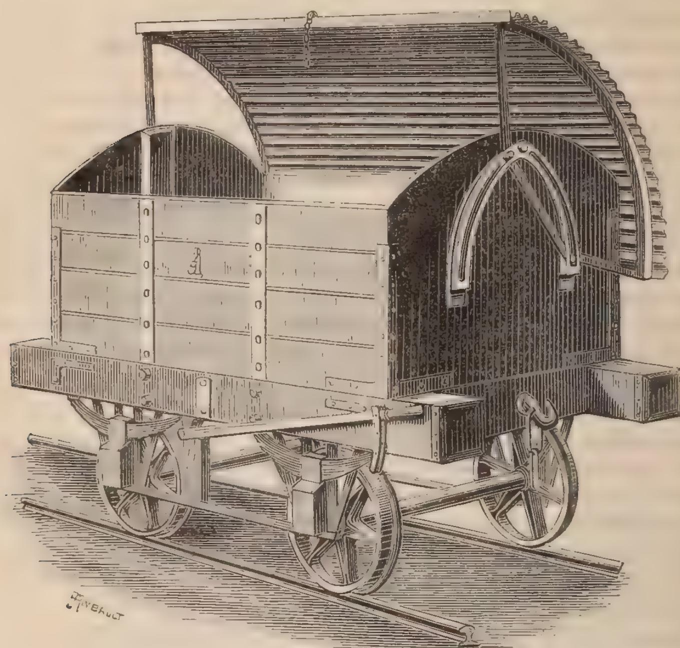
Messrs. W. N. Nicholson and Sons, of Newark-on-Trent, had a new Turnip-cutting Machine, with a movable cutter-bar to prevent roots from packing in the machine. Under the first cutter is a revolving roller with hook-shaped knives, that catch the last piece of root, which is often liable to slip through the machine and be wasted, sheep being unable to eat it without its being cut. The same firm have a Diamond-shaped Turnip-cutter, with a hollow disc, that allows of the root falling into the centre without being able to block there; by this arrangement the power required for working is lessened.

Messrs. W. Brenton, St. Germans, Cornwall, showed a working-model of corrugated galvanised Stack Roofing, laid on in sections, and fastened with iron keys, fitting into loops projecting from the under sheet, a piece of wire running over each end to prevent the wind from lifting it. One section can be removed without affecting the security of the whole.

Messrs. Thomas and Co., Oswestry, exhibited a novel and exceedingly good Cover for Waggons, or Corn-bins, that are exposed to

the weather. The cover is made of galvanised corrugated steel, and laid on lengthwise of the waggon, as shown in the accompanying drawing; and, being arched across, it gives the

Fig. 15.—*Messrs. Thomas and Co.'s Corrugated Iron Cover for Waggons.*



greatest possible strength, with a minimum of weight. The steel is fitted to a frame of angle- and tee-iron, resting on pivots (when the roof is closed), in the bottom of slots, of the arched brackets shown in drawing. The roof may be locked on both sides, and opened from either side without unlocking the other. The opening is effected by lifting the eaves to the centre, in the opening; the roof revolves eccentrically carrying the front eaves a convenient distance above the centre of the waggon. The contrivance seems equally adapted for railway waggons.

Messrs. Arnold and Son, West Smithfield, had a Portable Syringe specially adapted for washing hops. The tube or cylinder is fixed on a metal foot "which stands on the bottom of the water vessel," and is made of brass. The plunger is of solid metal, and requires no packing. To the plunger is attached a spiral spring, which raises it into position when forced down. There are two simple ball-valves, and an independent tube runs

down the side of the cylinder, which carries the surplus water back into the vessel again, and prevents splashing.

Messrs. Atkinson and Phillipson, Newcastle-on-Tyne, exhibited Mortimer's Patent Brake, to which our attention was specially called. The principle is opposed to the old steel band clasping the nave of the wheel, this brake being an expanding steel spring covered with thick leather, and moved by an ingenious lever, which expands the ring to the inside of a hoop attached for the purpose to the nave of the wheel; the brake fitted to a carriage was tried, and found very effective. The exhibitors also stated that it had been applied to traction engines with success; the opinion of the Judges was that it was more applicable to carriages than agricultural waggons or carts; they however recognised the merit of the invention, and are pleased to make a record of it in the 'Journal.'

Messrs. J. H. Peck and Co., of Wigan, offered a new and most durable Nose-bag for Horses. It is very strong; the weft is tarred cord, and the warp plain whipcord. It is ventilated by three brass eye-holes at the front, and two similar ones at the back, that allow of a cord being tied through them, to prevent the horse from throwing out his corn. The price is 4*s.* 6*d.* each.

Figs. 16 and 17.—*Mr. W. Burch's Spring Egg Carrier.*

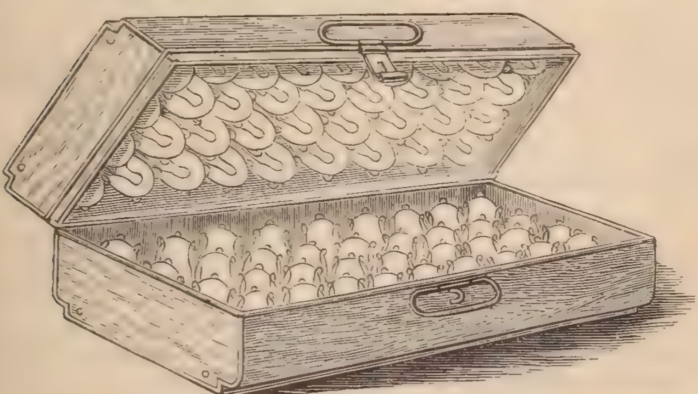


Fig. 16.—View.

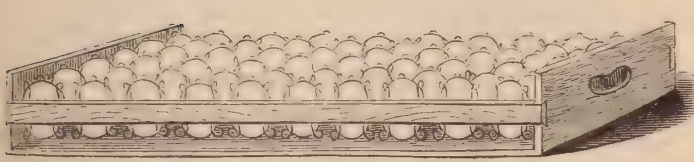


Fig. 17.—Section of Box.

Mr. W. Burch, Covent Garden Warehouse, St. James Street, W.C., exhibited a most useful contrivance for the hen-wife and the general public. It is called the Ovifer, or Spring Egg-Carrier. The contrivance consists of three elastic steel springs, fixed just sufficiently far apart to prevent the eggs from touching each other. The egg is pressed into the top, which opens to receive it, and then closes firmly round it. When the box is turned over, the eggs cannot drop out. No packing material whatever is required, and all risk from taint by mouldy hay is avoided. It is an established fact that an egg kept on end is preserved longer than if it had been laid on its side, especially so if turned over once or twice a week, which with this Ovifer would be the simplest thing imaginable. This little invention can be confidently recommended.

Before concluding, the Judges would wish to record their appreciation of all the arrangements made by the Society in the Working Dairy for their convenience and assistance, and also to thank the Stewards of the Department, Lord Vernon, Mr. Bowen Jones, Lord Moreton, and Mr. R. Neville, for their untiring energy and co-operation.

XXXVII.—*Report on the Trials of Implements at Reading.* By William C. Little, Stag's Holt, March, Cambs., Reporting Judge.

Amongst the Prizes offered for Implements at the Meeting of the Royal Agricultural Society were the following:—

Steam Draining Machinery.

Class 1. The most efficient and economical apparatus for excavating field-drains .. .. The Gold Medal.

Milking Machine.

	£
Class 4. The best milking machine, to be tested during the six consecutive months of the spring and summer of 1883	50

Straw Compressing and Binding Machine.

Class 5. The most efficient portable straw-compressing and binding machine, to be worked in conjunction with a threshing machine	25

Hay and Corn Drying.

Class 6. The most efficient and economical method of drying Hay or Corn crops artificially, either before or after being stacked ..	105*

* Offered by Martin J. Sutton, Esq., of Reading.

CONDITION APPLYING ONLY TO CLASS 6.

The exhibition of the apparatus entered in this Class will not be an absolute requirement, but appliances for the purpose already fixed, or which may be fixed at farm homesteads, will be eligible to compete. Competitors who cannot exhibit their apparatus will, however, be required to send in plans or models of their system with a full description of the method. Apparatus of a portable character *must* be exhibited at the Show.

These four Classes of Implements were submitted to the adjudication of the same three Judges. Fortunately for these Judges, who found their hands pretty full, all the entries in Classes 1 and 4 were withdrawn before the time for exhibition. It must, however, be considered a matter for regret at a time like the present, when the benefit of efficient drainage is universally recognised, when the necessity of draining or redraining an immense quantity of land has been too clearly proved, and when the cost of this work has been so largely increased by the high price of manual labour, that the offer of the Society had not the result of stimulating the machine-makers to compete for the Gold Medal.

CLASS 5.

Straw Compressing and Binding Machine.

In this Class only one implement was exhibited. The entry in the Catalogue was as follows:—

Stand No. 267.—*John H. Ladd & Co., of* 116, *Queen Victoria Street, London.*

Article **5017**.—Straw Compressing Machine; manufactured by the Exhibitors. Price 172*l.* 17 in. by 22 in., variable length, extra strength, iron-lined belt, perpetual press, mounted on wheels for travelling. (*For Trial.*)

The machine received the Silver Medal of the Society in 1881, and a full description of it, by Mr. Coleman, appeared in the 'Journal' for that year.* The exhibitors in their prospectus are content to give Mr. Coleman's graphic report as a complete exposition of the construction and the action of this implement. It will be sufficient to say here that the material to be compressed (hay, straw, &c.) is fed into a hopper, from which it is driven down into a lower chamber by means of a board which descends with a blow at regular intervals. As this board is withdrawn, pressure is applied by a solid and weighty traverser acting horizontally; the straw or other material is driven into a chamber which is fitted with steel springs, and these retain all that is forced beyond them. The size of the bales is regulated as to height and width within the limits of 17 inches by 22 inches, by enlarging or contracting the mouth of the chamber.

* Vol. xvii. p. 604.

The bale may be made of any convenient length. Between the different bales a wooden slide or *follower* is inserted at the hopper end of the chamber. As the bale travels onward, wires are passed through the sides of the chamber and along the grooves of the followers. The ends of these are brought together, and a twist with a pair of pincers secures them. When the truss is liberated, a slight expansion of the material tightens the wires and gives them sufficient hold of the truss.

As the prize was offered for an implement to be worked "*in conjunction with a threshing-machine*," arrangements were made for passing straw through a threshing-machine, and from it to the perpetual press.

An 8-horse-power engine having been attached to the press, 1 ton of straw was fed into the threshing-machine, and after passing over the shakers it was pitched up on to a platform, where the attendant who supplied the hopper of the press stood. Care was taken to feed the machine at about the same rate as if it had been required to thresh the corn, and the press took the straw nearly as fast as it was delivered. In 59 minutes the whole of the straw had been baled; but of this time about 8 minutes had been lost by the strap slipping off, and other hindrances. Twenty-seven bales, averaging about $22\frac{1}{4}$ inches $\times$ 19 inches $\times$ 32 inches, were made, and their total weight was 18 cwts. $8\frac{1}{2}$ lbs.* This gives an average weight of 75 lbs. per bale, or about $9\frac{1}{5}$ lbs. per cubic foot, or 9 yards to the ton. The average size of a bale was 8·164 cubic feet, average weight 75 lbs., weight per cubic foot 9·186 lbs. The bales were weighed in lots of three each. The heaviest lot weighed 272 lbs., the lightest lot weighed 172 lbs.

The density of these bales was nothing like what was expected, and what the exhibitors professed that they could accomplish. They complained that the straw was damp, which was true, and certainly their feeder used no great exertion, for he never took his coat off. But it seemed that in order to keep pace with the threshing-machine it was necessary to open the mouth of the press-chamber, and thus to reduce the compression. Mr. A. Carey, Assistant-Engineer, superintended the working of the steam-engine attached to the press, and he reported that fully 8-horse-power had been employed.

The Judges reported to the Stewards their opinion that no prize should be awarded, inasmuch as—

1. The prize is offered for a machine which is to be "worked in conjunction with a threshing-machine," and the exhibitors had made no arrangements for adapting their implement to that purpose.

---

* As a brisk wind was blowing all the time of the trial, and the straw was considerably broken, a good deal of it blew out of reach.

2. The power required to work this implement is not less than 8-h.p., and this addition to the power ordinarily required to work a threshing-machine appears to us to be fatal to the adoption of this machine for the purpose evidently contemplated by the Society.

(Signed) MASON COOKE.
WILLIAM LITTLE.
GEO. H. SANDAY.

Mr. Scotson, who acted as one of the Judges at Derby, suggested to the Secretary of the Society that it would be very interesting to try the effect of pressing green half-made hay and storing it for a while. He had previously expressed the opinion that the close packing would prevent fermentation, and that this machine might be valuable to hay-growers by enabling them to secure their crops in a greener state, and thus in more valuable condition for marketing. The Judges and the exhibitor were willing, and even anxious, to carry out this experiment, and grass was actually mown for the purpose, but it was necessary to have it in dry condition, and the weather, which has so much to answer for in connection with the Reading Show, was such that it was impossible to secure dry grass in time for a trial.

CLASS 6.

Hay and Corn Drying Machines.

During the last six or seven years the growers of hay and corn in Great Britain, that is, the farmers, have suffered a very great loss from continued wet weather at the very period when their crops should have been gathered in. Such things have, no doubt, happened frequently before; but never before in the memory of man have so many wet summers and autumns occurred in succession; and the trials and troubles of the farmers have been enormously increased by the untoward weather which has almost invariably prevailed at the most critical part of the agricultural year. The injury which corn crops sustain by a wet harvest-time has always been appreciated by the British public. Those who are old enough to remember the days before Free Trade will call to mind how a single rainy day in harvest had a marked effect upon the corn market, while a rainy week at that season raised prices sufficiently to unearth hoards of corn laid by in anticipation of such chances by well-to-do farmers and speculating merchants. This country no longer depends upon the home-crop of corn, and there is much less speculation and storing of corn than there was in the days of Protection; yet even now the price of corn is sensibly affected by the prevalence of bad weather during harvest.

But in the case of the hay-crop it is doubtful whether any but those who are really interested in the matter have any idea

of the very large sum at stake when the "haysel" or hay-making time arrives. There are no means of determining accurately what is the extent of land which is mown for hay in Great Britain, but there are good grounds for supposing that it cannot be less than 6 million acres. The Agricultural Returns since the year 1878 have not distinguished the area of grass lands intended to be mown for hay; but if we assume that as large a proportion of the total extent is now mown as was then mown, we had, in 1880–1881, on the average $6\frac{1}{6}$ million acres of this crop.*

Taking into account the fact that a large quantity of the clover is cut twice in the year, it may be estimated that the average value of an acre of hay would not be less than 4*l.* The value of the hay-crop of Great Britain may thus be fairly reckoned at not less than $24\frac{1}{2}$ millions sterling a year.

It may be added that several causes have contributed to make this crop of greater relative importance to farmers generally during the last few years. Not only has a large quantity of land been laid down to grass, but the live-stock of the country are fewer in number; and it is a matter of common observation that too many farmers have been unable, on account of their poverty, to stock their land fully; and unstocked land, whether good or bad, must be mown. Again, under the pressure of

* TABLE showing the Acreage of Permanent Pasture and Grasses under Rotation in Great Britain in 1877 and 1878 (mean area), and also the Acreage and Percentage of the Total Acreage of these Crops intended to be mown for Hay.

	Acres. 000 omitted.	Percentage of Total.
Permanent Pasture:—		
For Hay	3,799	27·5
Not for Hay	10,020	72·5
Total Permanent Pasture	13,820	100·0
Clovers and Grasses under Rotation:—		
For Hay	2,242	49·5
Not for Hay	2,292	50·5
Total	4,534	100·0

TABLE showing Acreage of Permanent Pasture and Grasses under Rotation in 1880–1881 (mean area), with Estimated Extent of Hay-Crop, based on the Proportionate Area of that Crop in 1877–1878.

	Acres. 000 omitted.	
Permanent Pasture	14,535	
$27\frac{1}{2}$ per cent. thereof	..	3,997
Clovers and Grasses under Rotation	4,388	
$49\frac{1}{2}$ per cent. thereof	..	2,172
		6,169

Or, more correctly, 6,169,388 Acres.

adverse times many landlords have given their tenants, who had until recently been strictly prohibited from selling any hay, the privilege of marketing at least a portion of their crop. In such cases the value of the hay to the farmer, if it be well got, is much increased, and his risk and loss from bad weather are increased in the same ratio. Notwithstanding the largely increased sale of hay by farmers, the price of good hay has been high, and the demand for it seems to increase every year. Packing- and trussing-machines, by reducing the bulk and rendering the material more portable, extend the area from which supplies can be drawn; and by their means many farmers who were formerly excluded are brought within reach of a market.

It may then be said with certainty that on the average the British farmer has now, as compared with ten or fifteen years ago, a larger part of his farm in grass, and a larger portion of that grass mown for hay; that he is more at liberty, and avails himself of that liberty, to sell his hay; and that if he can secure it in good condition, he makes a bigger price of it than he ever did before.

The very cause which has made the farmer more dependent upon the hay-crop than formerly, namely, the wet seasons, has at the same time seriously interfered with his success in this branch of agriculture. In proportion to its value, hay is perhaps more susceptible of injury by a short spell of rainy weather than corn is; and great as are the losses caused by continuous wet weather at harvest time, they are perhaps in a series of years equalled by those done to the hay-crop by the proverbially fickle climate of this island. Any invention or discovery which would make the hay and corn growers independent of the weather, at the season of in-gathering, would be of incalculable benefit to the Agriculturists of the country, and not only to them, but to the whole community.

At this juncture it has been asserted, and it is no doubt believed by some enthusiasts, that the means of successfully combating the adverse influences of our climate have been discovered. Mr. Gibbs, of Gillwell Park, Essex, asks plaintively, "Why will you waste 6 million pounds a year, when the proved means of saving this amount are offered you?" And an Agricultural Critic, "Agricola," writing in 'The Field' newspaper some "Practical Notes on the Neilson System of Harvesting," which have since been published as a pamphlet,* asserts that "the discovery has been made that hay and corn *may be harvested in continuous rainy weather as perfectly as when the skies are clear and the sun shines brightly.*"

* 'Harvesting Crops independently of Weather.' By Agricola. London, 1882.

TABLE I.—LIST of EXHIBITORS of MACHINES for DRYING HAY and CORN artificially.

Sub-Class.	Method Adopted.	Time of Application of Method.	Exhibitors.	Corresponding Number of the Article in the Catalogue.
A.	By hot air, "Gibbs's Method."	Before Stacking ..	W. W. Champion, Whitley Manor Farm, Reading	6094
B.	By exhaust fans, "Neilson System."	In the Stack	The Agricultural and Horticultural Association, Limited, 3, Agar Street, Strand, W.C., and 3, Creek Road, Deptford, S.E.	4394 4395
			A. C. Bamlett, Thirsk, Yorkshire	4025 4026
			James Coultas, Grantham	2224
			William A. Gibbs, Gillwell Park, Chingford, Essex	3855 3856
			R. A. Lister and Co., Dursley, Gloucestershire	376
			Charles D. Phillips, Gaer Fach Farm, and Emlyn Engineering Works, Newport, Mon.	5232 to 5244
C.	By ventilation, assisted by hot air.	In the Stack	C. Kite and Co., 117, Chalton Street, Euston Road, London, N.W.	4000

These statements have been repeated and endorsed by many newspaper writers, most of whom indulge in the usual sneers at the folly and ignorance of farmers in neglecting to avail themselves of the discoveries of science, while some express a charitable hope that now at last the British farmer will not close his ears and eyes to this ascertained remedy for losses which may occur season after season.

Under these circumstances, when Mr. Martin J. Sutton, a member of the well-known firm of Sutton and Sons (seedsmen), Reading, generously offered for the acceptance of the Royal Agricultural Society a prize of 100 guineas for "the most efficient and economical method of drying Hay or Corn crops artificially, either before or after being stacked," the Council of the Society were acting with their usual public spirit in accepting that offer, and undertaking the onerous and costly enterprise of testing the different methods which might be submitted for competition. In making arrangements for the trials in connection with Mr. Sutton's prize, the efforts of the Society were warmly seconded by the Reading Local Committee and the Reading Corporation in their capacity of owners and cultivators of the Reading Sewage Farm.

Before proceeding to describe the different machines and appliances entered for competition for this prize, and the trials which were carried out by the Stewards and Judges of the Society, it will be well to enumerate the competing methods, classifying them according to the means employed.

The Judges met in the Showyard on Monday the 3rd of July, and immediately proceeded to inspect the articles entered for trial in the Classes with which they had to deal. Owing to mistakes and delays on the part of the Railway Companies, some of the machines had not arrived, and others which were on the ground wanted a few finishing touches.

Sub-Class A.

Gibbs's Hay Dryer.

Exhibitor—William W. Champion, *of Whitley Manor Farm, Reading.*

Article **6094**—Hay Dryer, Gibbs's; manufactured by William A. Gibbs, Gillwell Park, Chingford, Essex. Price 350*l.* To be used in combination with duplex fan.

The following description of this machine by Mr. Anderson the Consulting Engineer of the Society, will convey to the reader as good an idea of it as can be formed without an actual inspection.

This machine consists of a furnace for heating air, and a fan for propelling it into the haymaking-machine, which is an arrangement by which the

damp hay is agitated, while a current of hot air is driven through it to dry it. The machine is driven by an 8-horse portable engine by means of a belt. On the fan spindle is keyed a driving pulley, 23 inches in diameter by 9 inches wide, and a fan 5 feet 4 inches in diameter by 21 inches wide, with four blades and inlets 24 inches in diameter. The fan is surrounded by a sheet-iron casing, and the inlets are enclosed with similar material, and formed on each side into a furnace about 8 feet long and 2 feet wide. On the grates of these furnaces coke is burned, and the products of combustion are forced by the fan through a sheet-iron trunk, 2 feet 2 inches by 2 feet, into the drying-machine, the supply being regulated by a throttle valve, and the temperature ascertained by a pyrometer. The whole apparatus is carried on a pair of iron wheels, 48 inches in diameter by 7 inches wide, and provision is made for attaching a pair of shafts to the furnace end of the fan case. A spark guard, made of sheet-iron, rests on the ground, and encloses completely the lower portion of the fan casing. On the side of the casing opposite to the driving-pulley a bevel pinion is keyed on to the fan-spindle, and this gears into a bevel wheel about three times its diameter, keyed on to a shaft at right angles to the fan-spindle, and connected to an inclined shaft by means of a universal joint; the other end of the shaft is connected by a similar joint to the driving-gear of the haymaking-machine.

The haymaking-machine is about 27 feet long by 8 feet wide. It consists of a framing or skeleton trough, which, at about 6 feet from the gearing end, rests upon a pair of wooden wheels, 48 inches in diameter by 6 inches wide, while the other end is suspended from wrought-iron skeleton standards resting independently on the ground, and fitted at their upper ends with chain pulleys, and at their lower with chain-drums actuated by tangent gear. By means of this arrangement any desired inclination may be given to the frame. The trough or frame carries a sheet-iron screen, made like the ridge of a roof, with a rise of about 1 foot 9 inches, and capable of having a reciprocating motion communicated to it, by means of a crank having a 9-inch throw. To facilitate this motion the screen is carried on three pairs of 8-inch rollers keyed on to shafts which cross the trough, and revolving on bearings secured to its sides.

To each side of the trough is fixed a framework consisting of seven uprights connected together at their tops. These carry, on each side of the machine, a crank shaft of 18 throws, and each throw carries a prong 3 feet long, projecting down into the screen and close to its bottom. The prongs are projected 15 inches backwards, and these short ends are connected by chains to a bar which runs the whole length of each side of the machine and some 22 inches outside the uprights. The bars are carried on outrigger brackets, and are capable of being moved longitudinally about 12 inches by means of adjusting screws and handles at one of the ends, the object being to give the prongs, which are very loose on their cranks, a kind of double motion which tends to makes the hay travel longitudinally.

To the framing over the screen is attached on each side a longitudinal bar, to which are hinged cross-bars, seventeen in number, from which project downwards short two-pronged forks, so arranged that each crank-prong has a fork coming over it. The office of the prong is to clear the hay off the crank-prongs as they revolve.

Over the ridge of the screen is a sheet-iron flue, divided longitudinally down the centre so as to make two parallel flues, and these are connected to the fan and fitted with regulators, so that the hot air may be distributed uniformly on both sides of the screen. The flue is supported on adjusting screws, so arranged that the distance of its edge from the screen may be varied at pleasure.

The inclined shaft from the fan-case gives motion, by means of a pinion

and wheel, to a crank shaft which crosses under the trough of the machine at its extreme end, and actuates a connecting-rod which communicates a reciprocating motion to the screen. The crank-shaft also, at its further end, communicates its motion to an upright shaft placed at the extreme end and on one side of the trough; and this upright, by means of bevel wheels, actuates the multiple crank-shaft which works the prongs. On the opposite side of the machine is a similar arrangement, deriving its motion more directly from the crank-shaft from the fan.

The rate of traverse of the hay while it is being dried depends upon the inclination given to the screen and to the lateral set given to the prongs.

On the 1st of July, when the Judges made their preliminary inspection of Implements in the Showyard, they saw—

1. The Hay Dryer, like a gigantic straw elevator, guarded on each side with a *cheval de frise* of vicious-looking prongs, and mounted on four wheels. One of the Judges gave this cumbrous and unwieldy article the appropriate name of "Jumbo," by which name it was thenceforth known. When the order for its removal to the trial ground was given, Mr. Carey, Assistant Engineer, was sorely exercised about getting it over the narrow bridge which was the only entrance to the Fobney meadows, as the width of the wheels was greater than the space between the fixed iron guards of the bridge; but this difficulty was surmounted by raising the machine sufficiently for the hubs of the wheels to run above the bridge-guards. This part of the machine required four horses to move it.

2. The furnace and fan, with a big trunk elevated in the air, and designed to convey the hot blast to the dryer (No. 1). As the consort of "Jumbo," this part of the apparatus was nicknamed "Alice." It was mounted on two wheels, and required two horses to move it.

3. A tumbrel containing standards and windlass for supporting and regulating the height of the delivery end of the dryer when at work: and sundry tools and odds and ends required for working.

4. In addition to these parts, which complete the apparatus itself, an engine of 8-horse-power is required to work the machine.

The trial of this apparatus in the field will be recorded hereafter; but it may be mentioned here, that when an occasion for moving it from one situation to another occurred, it was found that about two hours were occupied in getting the whole thing under weigh, and eleven horses were required for the removal.

Sub-Class B.

Exhaust Fans:—Neilson System.

All the machines and appliances included in this sub-class are designed for working the "Neilson System" of drying hay

or corn in the stack. The essential characteristics of this method are these: By means of a fan communicating by an air-tight passage with a central cavity in the stack the hot air is withdrawn from the inside, in consequence of which the cooler and drier air of the outer atmosphere rushes through the interstices of the hay or corn, and in its passage cools and dries the stack. The motive power, the mechanical means of exhausion, the junction of the horizontal flue with the machine, the size and position of the flue, and the proportions of the shaft or central cavity, may vary, but the principle is the same in all. This method is the invention of Mr. Neilson, of Halewood Farm, near Liverpool; and it is impossible to name this gentleman without saying a few words in acknowledgement of the debt which is due to him, not merely for the untiring zeal and energy with which he has carried on his experiments with the view of perfecting his method of harvesting crops independently of weather, but also for the public spirit and self-denial which he has shown in declining to patent his process. Whatever the value of the invention may prove to be, and the inventor himself is sanguine as to its future success, he has made a free gift of it to the public.

It is proposed at this point to give some description of the different exhaust fans which competed for the prize as they were exhibited in the Showyard; and afterwards, in relating the trials to which they were subjected, to notice the variations in the practical application of the principle by individual exhibitors.

Taking these machines in the alphabetical order of the exhibitors' names, the first to be noticed is thus entered in the Catalogue:

Stand No. 206.—*The Agricultural and Horticultural Association (Limited) (E. Owen Greening, Managing Director), of* 3, *Agar Street, Strand, W.C., and* 3, *Creek Road, Deptford, S.E., London.*

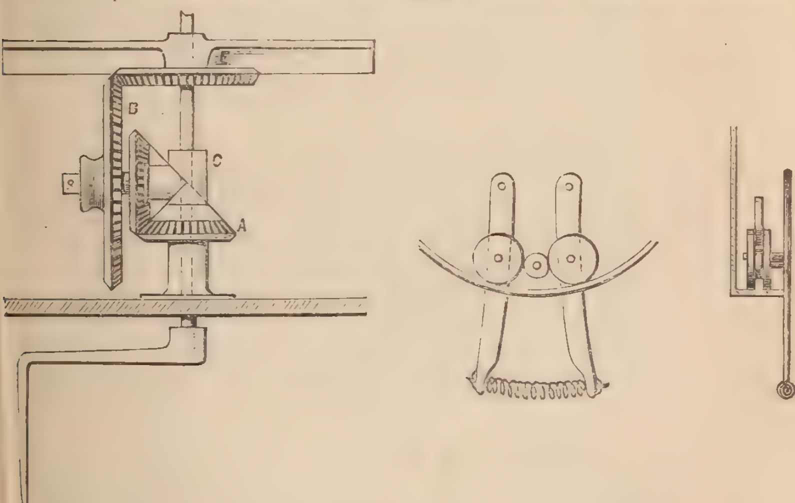
Article **4394**—(*New Implement.*) — Hay and Corn Drying in Stack, "One and All," portable system; manufactured for the Exhibitors. Price 14*l.* for exhaust fan on wheels. Galvanized iron and pipes, centre air chamber and thermometer extra, if required. This system is applicable to single stacks, whether in stack-yard or field, and can be worked by hand power. (*For Trial.*)

The fan here exhibited is thus described by Mr. Anderson, C.E. (the Consulting Engineer to the Society):—

This machine is a fan for the purpose of ventilating stacks. Apparently with the object of reducing the bulk of the apparatus to a minimum, a very simple movement has been produced by the most complicated means. The fan is four-bladed, 15 inches in diameter, with a single inlet 6 inches in diameter. It is placed at the bottom and one side of a wooden box, mounted on a pair of wheels, and fitted with a pair of shafts. The box also contains all the following

mechanism. The hand-shaft passes through the upper part of the centre of the box; it is fitted with a wooden handle at each end, and works in bearings secured to the sides of the box. On the same side with the fan the hand-shaft passes through a short sleeve bolted to the side of the box, and carrying a small bevel pinion, Fig. 1 (A). This gears into a pinion of the same size (B), revolving freely round a stud secured to the lower T-piece (C), which is free to revolve round the hand-shaft. Secured to the pinion (B) is the larger bevel-wheel (D), which engages into a wheel (E), secured to a large driving-wheel which runs loose on the hand-shaft. This driving-wheel has an annular rim on one side of it, and on its bottom part run two friction rollers that are kept together by means of a pair of levers, the upper ends of which are pivoted to the casing, while the lower ends are held together by means of a spiral spring with screw adjustment; between these rollers comes a leather-covered pulley, keyed on to the far spindle. The rollers are kept in their places by the edge of a ring bolted to the driving-wheel, and running in grooves formed in the rollers. The ratio of speed between the handle and the fan is 49 : 1, so that at 30 revolutions of the handle, a very moderate speed, nearly 1500 revolutions of the fan can be obtained. This apparatus is by no means easy to work, and very unnecessarily complicated.

Fig. 1.—*Illustrating the Working Parts of Greening's Fan, No.* 4394.



The flue used with this fan is a half-round sheet-iron tube, 10 inches in width at the inner end and decreasing gradually to about 6 inches. The junction with the fan is effected by means of a flexible tube.

The exhibitors claim for this fan that, without being large, heavy, or cumbrous, it attains a great velocity, 45 revolutions of the handle giving 2430 revolutions of the fan, and 40 turns of the handle giving 2160 of the fan; but this speed is obtained by

the expenditure of considerable power. It is in fact beyond the power of two men to work it for more than a few minutes. The dynamometer trial (to be referred to at length hereafter) gave ·24 as the horse-power required to work the fan open as compared with ·11 required by Phillips's hand fan working at the same speed; and in the field, while one man worked Phillips's fan at the rate of 45–50 revolutions for fifteen minutes at a time, two men with difficulty worked the fan now under notice at 40 revolutions per minute.

The same exhibitors showed also a fan to be used as a fixture, and worked by steam, water, or horse-power.

Article **4395**—(*New Implement.*)—Hay and Corn Drying in Stack, "One and All," fixed system; manufactured for the Exhibitors. Price 7*l.* for the exhaust fan. Air pipes, air-chamber arrangement, thermometer, sliding valves, extra, if required, according to size of stackyard. This system is applicable to stacks in rows. The fan to be worked by steam or horse-power, or water-motor. (*For Trial.*)

This fan is a simple one of 15 inches diameter, with four rectangular blades 7½ inches wide, running eccentrically in a sheet-iron casing, 21 inches diameter, with a 3-inch pulley on the outside. The air inlet, which is on one side only, is 8 inches square. When worked, the frame was bolted on wood let into the ground. It seemed to the Judges to be of too flimsy construction to bear much work. The dynamometer trial gave 1·56 as the horse-power required to give 1500 revolutions of the fan; as compared with Phillips's power machine, which took 1·77 horse-power for 2052 revolutions, and Lister's, which took 1·75 horse-power for 1000 revolutions; while the water-gauge test showed a displacement 2·45 in. against Phillips's 2·85.

The exhibitors state that they have "simply studied to obtain the utmost simplicity with efficiency, discarding all gearing."

Stand No. 187.—*A. C. Bamlett, of Reaper Works, Thirsk, York.*

Article **4025**—(*New Implement.*)—Corn and Hay Dryer; manufactured by the Exhibitor. Price 10*l.* An apparatus for drying corn and hay in stack. (*For Trial.*)

The fan in this case is an unenclosed turbine wheel, 14 inches in diameter, and $4\frac{11}{16}$ inches in width, made in one piece, and driven by a strap from a wheel 54 inches in diameter on to a pulley of about 3 inches. The air inlet on one side of the drum is $7\frac{1}{4}$ inches in diameter. The flue used is a wooden box, $5\frac{3}{4}$ inches square, with a cast-iron cap for fitting on to the machine. The fan and driving-wheel are on a light skeleton

framework of wood, supported at one end by a couple of struts, and at the other by a stake, which is driven into the ground, the height of the fan-wheel being easily adjusted to the stack-flue by raising or lowering the framework and fastening it at the required height to this stake. When the fan is to be moved, the driving-wheel acts as a wheelbarrow-wheel.

Nothing could be more simple than this machine. The strap used was of untanned leather, and in the field one man maintained an average speed of 60 turns of the handle per minute for a considerable time. This gave 1050 revolutions of the fan per minute. The horse-power required to effect this was, according to the dynamometer trial, ·33, while the displacement shown by the water-gauge at this velocity was ·7 inch.

Stand No. 113.—*James Coultas, of the Perseverance Iron Works, Grantham, Lincolnshire.*

Article **2224**—Hay and Corn Drying Apparatus; manufactured by the Exhibitor. Price 15*l.* This patented apparatus conditions hay, corn, seeds, and all classes of grain in the straw, while in the stack, and enables the above to be carted at a much earlier date; the heat and damp can be drawn off at pleasure by the use of exhauster driven by ordinary steam-engine. Extra if mounted on wheels and fitted with shafts, 3*l.* (*For Trial.*)

This was the monster machine of the Exhibition (see Figs. 2 and 3); the construction of it is, however, simple enough. The fan, which is 36 inches in diameter, has four blades, 14 inches wide and 12 inches deep, and works in the centre of the enclosing case. A $7\frac{1}{2}$-inch pulley on the outside is driven direct from the fly-wheel of a 4-horse-power engine. Three circular inlets (see Figs. 2 and 3, A. B. and C.), 9 inches in diameter, are provided, each one of which can be connected with a separate stack or range of stacks, and any one of these branches may be closed or opened instantly by inserting or withdrawing a slide or damper. The fan is mounted on a pair of strong road-wheels, and is fitted with shafts for removal. Attached to the front framework are a couple of strong upright planks, which rest on the ground, and support the machine in position. The inlets for the air are some 30 inches above ground, and the connection between them and the earthenware pipes is effected by means of cylindrical sheet-iron tubes, which proceed at first horizontally, and then turn at a right angle downwards. This is a somewhat important point to notice, and it seems necessary to call attention to it, because the published plates show a gradual curve in place of the abrupt turn actually taken.

Fig. 2.—*Elevation of Coultas's Fan, No.* 2224.

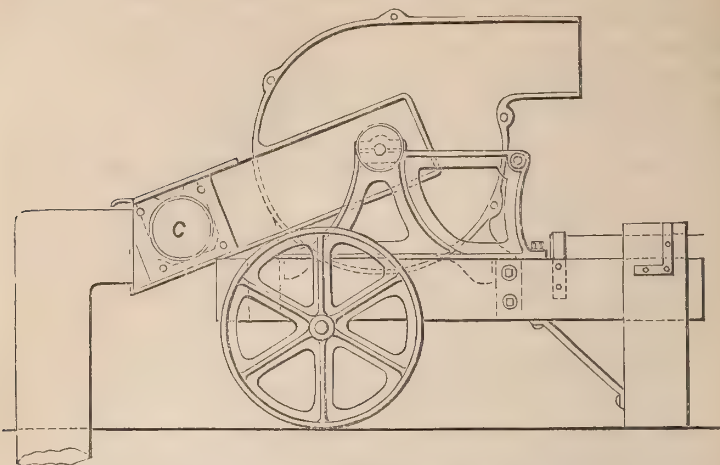
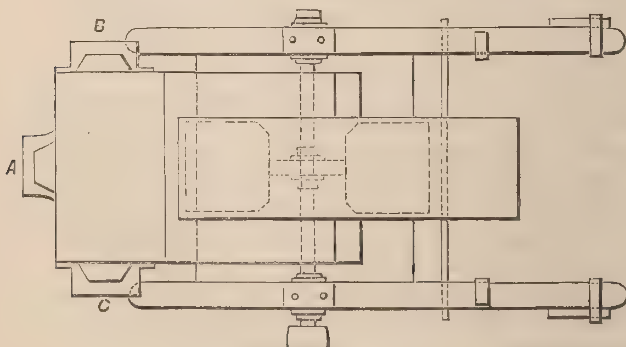


Fig. 3.—*Plan of Coultas's Fan, No.* 2224.



Stand No. 174.—*William Alfred Gibbs, of Gillwell Park, Chingford, Essex.*

Article **3855**—(*New Implement.*)—Fan, for Stack Cooling; manufactured by the Exhibitor. Price 8*l.* A rough, but strong and effective machine, constructed to enable farmers to test this plan fully at the smallest outlay; suction-power for 6 or 8 stacks seriatim, can be carried from stack to stack, fixed and unfixed in a minute, and worked by one or two men. Can be used as a fixture and worked by hand, horse or steam power. (*For Trial.*)

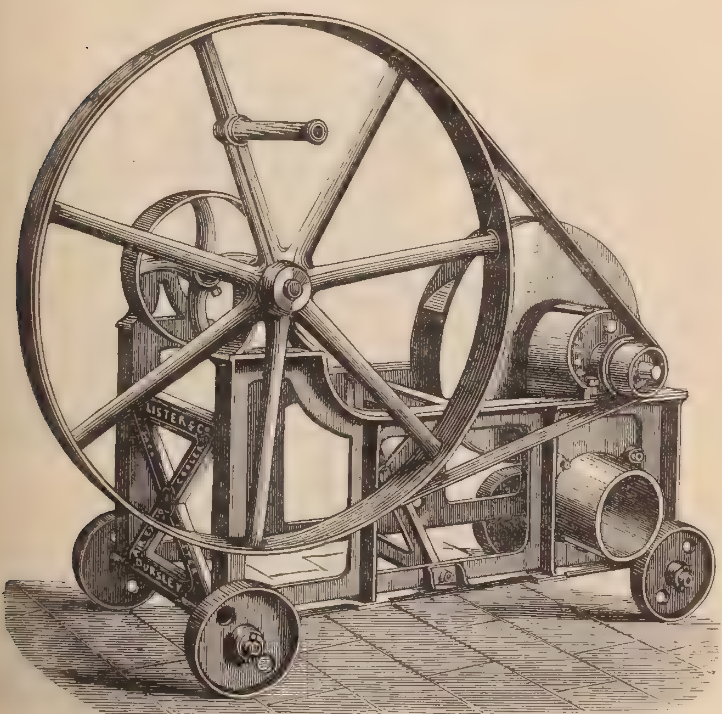
This is a simple beater-fan, of $20\frac{1}{2}$ inches diameter, with four rectangular blades, $6\frac{3}{4}$ inches wide, working in the centre of a sheet-iron case, and driven by a cog-wheel and pinion.

A handle is fitted on the cog-wheel, and one revolution of this wheel gives 13 revolutions of the fan. The air inlet is 8 in. × 8 in. The fan-case when in use is fitted on to a wooden tube, which is placed horizontally in or under the stack, and at its outer end bent upwards at an angle of about 60°. This fan was only exhibited in connection with Gibbs's Hay Dryer. The stack of hay which had been operated upon by the dryer never generated sufficient heat to require the working of the fan.

Stand No. 31.—*R. A. Lister and Co., of the Victoria Iron Works, Dursley, Gloucestershire.*

Article **376**—(*New Implement.*)—Fan, for Exhausting Heat from Ricks; manufactured by the Exhibitors. Price 15*l.* This can be worked by two men, or is suitable for driving with horse gear, or steam or water power. (*For Trial.*)

Fig. 4.—*View of Lister and Co.'s Fan, No.* 376.

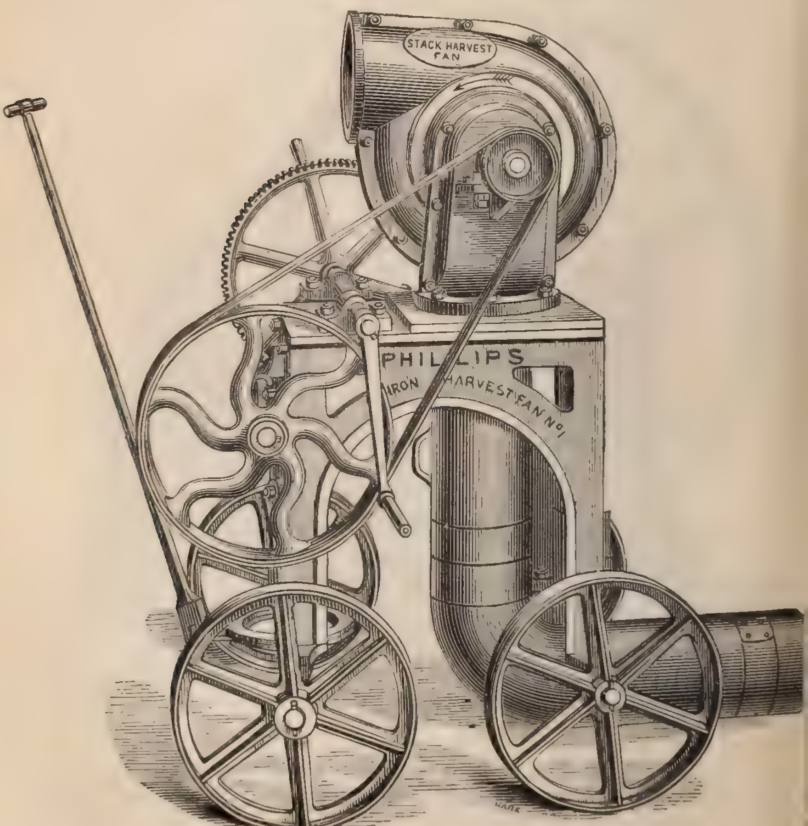


This fan (see Fig. 4) is an unenclosed centrifugal drum, 26 inches in diameter and 5 inches wide. The air enters on one side only, by an inlet 9 inches in diameter. The motion

when worked by hand is from a fly-wheel, by a strap on to a pulley. This fly-wheel can be applied on either side of the implement, and with one on each side two men can work well together. It requires, however, too much power for hand; 40 revolutions of the handle give only 400 revolutions of the fan per minute, and at this velocity the fan is almost ineffective. For steam-power a pulley is fixed on the same shaft as the fly-wheel. The machine is mounted on an iron framework fitted with four wheels. The flue used in the hay-field was an iron tube, resting on the ground.

The dynamometer trials showed that the power required to work the fan open at 800 revolutions per minute was ·89-horse-power; while to obtain 1000 revolutions, 1·75-horse-power was needed.

Fig. 5.—*View of Phillips's Fan, No.* 5233.



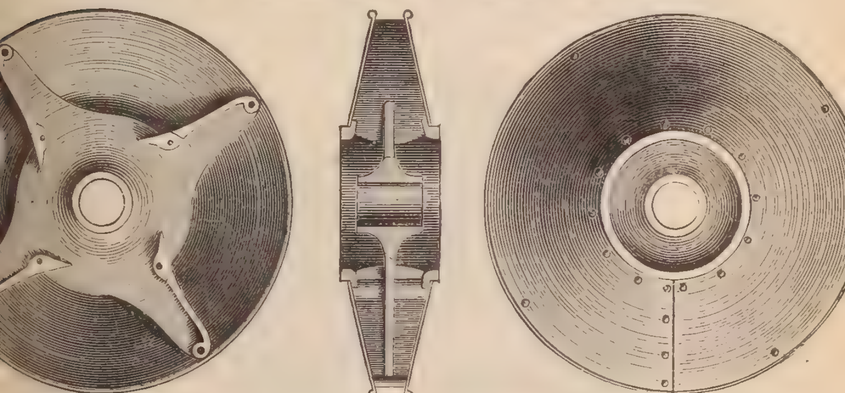
Stand No. 283.—*Charles D. Phillips, of the Emlyn Engineering Works, Newport, Monmouthshire.*

Article **5232**—(*New Implement.*)—Fan; manufactured by the Exhibitor. Price 9*l*. Phillips's improved exhausting and ventilating fan for stack cooling, or harvesting in the stack, with bearings outside, so that dust, sand, fibres, vapours, heated gases, &c., can pass through the fan without touching or injuring bearings. With steel spindle and long bearings, provision for efficient lubrication. Power required to drive it, 1-horse. (*For Trial.*)

5233—(*New Implement.*)—Fan; manufactured by the Exhibitor. Price 12*l*. Phillips's improved exhausting and ventilating fan. Similar to Article No. 5232, but mounted on pedestal and wheels, with self-contained counter-shaft and pulley for driving by horse gear and intermediate motion. (*For Trial.*)

The fan (see Figs. 5, 6, 7) in these machines (which are in that respect identically the same) is a drum like that of a centrifugal pump, 15 inches in diameter, with tapering blades $1\frac{1}{4}$ inch wide at the tip, $4\frac{1}{4}$ inches wide at the centre (see Fig. 6). The

Fig. 6.—*Plan and Sections of Phillips's Fan Wheel.*



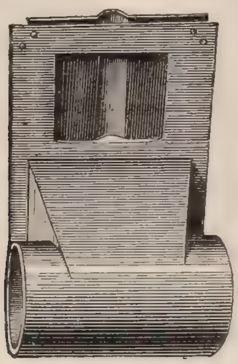
drum revolves in the centre of the case, the air entering on both sides of it. The machine is entirely constructed of iron, and is mounted on four wheels. When worked by hand-power a spur wheel drives a pinion, on the shaft of which is an 18-inch pulley, from which a strap runs on a 5-inch pulley. The ratio of speed of the motive wheel to the fan is 27 to 1, so that with forty turns of the handle per minute 1080 revolutions of the fan are given. When worked by steam-power a 5-inch pulley is substituted for the pinion wheel, and driven directly by a belt from the fly-wheel of the engine. By this means a speed of 2500 revolutions is easily obtained. The dynamometer trials gave 1·77 as the horse-power required to get 2160 revolutions; but in the field a $1\frac{1}{2}$-horse-power engine, working at very moderate

pressure, easily maintained the speed of 2500 revolutions per minute. The water-gauge test was not applied to this machine at a higher rate of speed than that of 2052 revolutions, but with that velocity 2·85 inches of water were displaced.

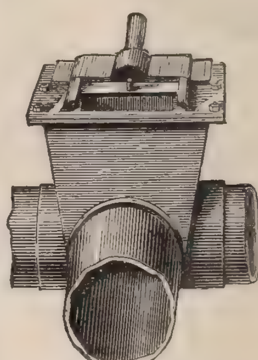
The inlet to this fan is 8 inches in diameter. It is prolonged to within a short distance of the ground; at the lower end the sides of the tube taper inwards, so that a tight joint is effected by inserting it in another tube; the junction with the flue is made with a curved galvanized-iron pipe.

This fan is intended to be used if required in connection with a series of stacks by means of fixed and permanent flues built in the ground. A very important feature in the fixed system is the damper which connects a particular stack with the exhausting apparatus, or disconnects them. Mr. Phillips exhibited damper boxes with close-fitting slides, which are opened or closed by means of a handle rod which extends to the outside of the stack. These boxes (see Fig. 7), which are of cast iron,

Fig. 7.—*Improved Damper Boxes by Charles D. Phillips, Engineering Works, Newport, Mon.*



Two hole Damper showing underneath part of slide and Box.



Damper Box showing three-way connections.

Damper and Box fixed.

are made with one, two, or three inlets, according to the position they are required to occupy in connection with other flues. The special peculiarity of these boxes is that the interior is rounded

in every direction to avoid the creation of any eddies or back currents of air which are the result of any irregularity in the form of the air passage.

Article **5234**—(*New Implement.*)—Fan; manufactured by the Exhibitor. Price 10*l.* Phillips's improved exhausting and ventilating portable hand fan, mounted on a strong wood framework, fitted with multiplying wheels. It can be worked by one or two men, and is complete with travelling wheels and handle. (*For Trial.*)

The entry, as printed above, does not correspond with that which appeared in the Catalogue, some mistake having occurred in the matter. The machine exhibited is described in the amended entry. The fan, 24 inches in diameter, has five blades of wrought iron, $10\frac{1}{2}$ inches wide, and works in the centre of a sheet-iron case. It is driven by a cog-wheel and pinion, one revolution of the former giving ten of the latter and of the fan. The air inlet is $7\frac{1}{2}$ inches by 10 inches. It is continued to the ground, where it fits into a wooden box flue. The machine is mounted on a stout wooden frame fitted with two wheels and handles for moving it wheel-barrow fashion. At the dynamometer trials the power required to work the fan open at the rate of 60 turns of the handle per minute was 0·42-horse-power. In the field two men relieving one another at intervals of 15 minutes kept up a speed of about 50 per minute.

Sub-Class C.

Ventilation in the Stack.

Stand No. 184.—*C. Kite and Co., of* 117, *Chalton Street, Euston Road, London, N.W.*

Article **4000**—(*New Implement.*)—Hay and Corn Dryer; manufactured by the Exhibitors. Price 4*l.* per single set. For ricks and stack sheds. This consists of perforated drums or pipes with automatic exhaust ventilator fixed on top, and placed perpendicularly along the middle of rick, to form one or more cavities as may be required, according to the size of stack. Also models of the above. (*For Trial.*)

The method proposed for adoption by the exhibitors is that of a central shaft, terminated by an automatic ventilator which rises above the roof of the stack. In connection with this shaft a pipe or pipes are laid horizontally at or near the bottom of the stack, and extending to the outside of it. A very slight indraught of air causes the ventilator to work, and thus to increase the velocity of the passage of air through the stack. If, however, the dampness of the atmosphere is such that there is no movement of air, a draught is easily created by the introduction of heated air supplied by a slow combustion stove. Although the Judges looked upon this apparatus as being of the nature of a toy, they did not feel justified in refusing it a trial.

Engineers' Trials of Exhaust Fans.

On the 19th of July the Exhaust Fans, which have been previously described, were subjected to a trial of their capacity and a test of the power required to work them. Mr. Robert Neville (Steward of Engineering) and Mr. William E. Rich (acting for the Consulting Engineer), assisted by Mr. A. Carey (Assistant Engineer), conducted these trials in the Show-ground. Mr. Beaumont, C.E. (correspondent of 'The Engineer' newspaper), assisted in taking the velocity of the air on entering or leaving the fan by means of one of Elliot Brothers' small air-meters, and the result of these observations is shown in the Table of Results (II.). The smaller dynamometer belonging to the Society was used in conjunction with a 4-horse-power vertical engine, made and exhibited by E. S. Hindley of Bourton. For the purpose of ascertaining the comparative exhausting power, a water-meter was employed. This instrument was a ½-inch glass tube, shaped like the letter U, one end of this tube was closed, and the other was connected by a flexible india-rubber tube with the air inlet of the fan. This inlet was closed by a blank flange through which the test tube passed. The gauge being graduated alike on both limbs, with the (o) zero point halfway up, water was poured in until it stood on both sides at zero. When the fan was worked, a partial vacuum was created, and the water rose on one side of the tube and fell to the same degree on the other. The displacement of water is read off as twice the rise in one limb, or rather the rise in one limb *plus* the fall in the other. It is necessary to explain that this test does not show what the fans would do when air from the stack could have free access, but it should give the comparative power of the fan to exhaust air.

The annexed Table II., constructed by Mr. Rich, C.E., gives both the main features of the machines exhibited, and the results arrived at by these trials, and the following remarks explain some apparent inconsistencies.

The discrepancies between the apparent manual powers required for working some of the fans on the stacks, and the powers required for working them in the dynamometrical trials, have been explained as follows by the Consulting Engineer, Mr. Anderson, and his partner, Mr. Rich, who conducted the trials on the dynamometer for him.

The hand dynamometer is one of the oldest and crudest of the Society's instruments, and certainly requires modernising and refining in its details and registering apparatus. Unfortunately, too, Mr. Rich had no opportunity of overhauling and adjusting it till the morning of the trial. However, with all its faults there is every reason to believe that the records published in the table, fairly represent the powers taken by the several fans relatively to one another.

It would have been much more satisfactory if the several fans could have

TABLE II.—RESULTS OF TRIALS OF FANS FOR HAY-DRYING APPARATUS AT READING, 19th July, 1882.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
					Trials with Inlet Closed.		Trials of Fans with Inlets and Outlets open.					
Catalogue Number.	Name of Maker.	Diameter and Width of Fan.	Speed of handle Shaft in revolutions per Minute.	Speed of Fan in revolutions per Minute.	Difference of Pressure in Inches of Water maintained.	Foot-lbs. of Work required per Minute to work Fan.	Size and Area in Square Feet of Inlet.	Mean Velocity of flow in said Inlet in ft. per Minute.	Calculated Volume of Air discharged per Minute by Fan in Cubic feet.	Foot lbs. of Work per Minute required by Fan.	Horse-Power required to Work Fan when open.	REMARKS.
		In. In.										
3855	Gibbs	$20\frac{1}{2} \times 6\frac{3}{4}$	40	520	·5	2,744	·44	..	..	..	..	Was removed before a trial with the case open could be made.
5234	Phillips's Wood Machine	24×10	40	400	·48	2,436	·52	..	..	3,652	·11	
	Do. Wood Machine	,,	60	600	·95	3,882	,,	2136	1110	13,740	·42	
5233	Phillips's Iron Machine	15 diam.	40	1080	·98	18,320	·31	1553	481	11,000	·33	
	Do. Iron Machine	,,	76	2052	2·85	53,730	,,	..	..	..	..	
	Do. Iron Machine	,,	80	2160	..	..	,,	2796	867	58,560	1·77	
376	Lister	26 ,,	40	400	·48	5,240	·42	1312	551	7,320	·22	
	Do.	,,	80	800	1·45	17,840	,,	2374	997	29,280	·89	
	Do.	,,	100	1000	..	..	,,	2994	1257	57,600	1·75	
2224	Coultas	36×14	..	840	..	..	·44	1930	849	140,000	4·24	One 9-inch side branch only open.
	Do.	,,	..	840	..	..	·88	2866	2522	201,600	6·11	Two branches open.
	Do.	,,	..	840	..	..	1·32	2294	3028	213,000	6·45	All three branches open.
	Do.	,,	..	1080	5·7	93,600	·44	2194	965	230,000	6·97	One side branch only open.
4394	Greening, No. 1 ..	$12 \times 5\frac{3}{4}$	40	2160	1·3	9,400	·21	984	207	7,840	·24	
4395	Do. ,, 2 ..	$15 \times 7\frac{1}{2}$	..	1500	2·45	29,700	·33	2858	943	51,450	1·56	
4025	Bamlett	$14 \times 4\frac{7}{8}$	40	700	·1	2,400	·30	1310	393	3,960	·12	Open fan on skeleton wood frame.
	Do.	,,	60	1050	·7	5,520	,,	2420	726	10,800	·33	
	Do.	,,	120	2100	2·9	18,840	,,	2702	811	54,960	1·67	

been tested when at work on their stacks, as neither the trials with the fan-cases, closed or open, can possibly represent the same conditions as would then exist, and consequently calculations founded on the dynamometrical figures might be misleading, so far as the stack-drying trials themselves are concerned.

On the stacks the powers required would generally be intermediate between those with the fans "open" and "closed," but very much would depend upon the density and size of the stacks, sizes of air-channels, &c., and with such machines very slight changes of speed and lubrication may immensely affect the powers required.

With regard to the remark that some fans require most power with the fan-cases open and others with them closed, that is quite to be understood from a mechanical point of view, and depends on the shape and conformation of the fans and the direction of the blades, whether radial, inclined, or curved.

There are no reliable experiments analysing this interesting question as regards fans for air, but it is generally known that a *well-designed* air fan requires *more* power to work it open, either against the atmospheric pressure, or against a moderate pressure in excess of the atmosphere, than when closed, to prevent any transmission of air through it. Some fans, however, with blades of an objectionable shape, probably require more power to work them closed; and the same phenomenon in others may be attributed to their being so placed in their cases as to admit of a churning of the air round and round within the case when working closed, and so corresponding to a transmission of air under more or less pressure.

Fans for water are better understood, but the same mechanical laws apply in both cases; and it is worthy of remark that a well-designed centrifugal pump working with closed outlet under a pressure of 10 ft., requires scarcely any power to work it, while the same pump discharging with an open outlet at the same height, will take a considerable power, possibly even five or ten times as much as before.

It will be observed that the fans were (1) tested with *inlet closed* for the purpose of observing "the difference of pressure in inches of water maintained" (cols. 5 and 6), and (2) with *inlet open*, when the velocity of the flow of air was observed.

Perhaps the most marked feature of these trials is the great increase of pressure, as shown by the water-gauge, obtained by an increased velocity of the fan. It will be seen that Bamlett's fan, when worked at 700 revolutions per minute, displaced only ·1 inch of water, while 1050 revolutions displaced ·7 inch, and 2100 gave 2·9 inches as the result. It may be noted here that 1050 revolutions can be got by 60 turns of the handle per minute, and that one man can without difficulty maintain this speed for a good while. It would be easy, by an intermediate motion, to double the velocity of the fan, and two men could then work it and obtain four times the result which one man now gets.

Phillips's hand fan was tested at 40 and 60 turns of the handle per minute, giving respectively 400 and 600 fan revolutions. The first speed represented what the Judges thought one man *would* do. The higher speed what Mr. Phillips's

representative thought a man *could* do. In the field a speed of 48 to 50 turns per minute was kept up by one man.

Phillips's iron machine, which is intended for either hand- or steam-power, was tried at 40, 76, and 80,—the low velocity representing hand-power and the higher speed what may be had by steam. In this case doubling the speed trebled the pressure.

Lister's, being adapted for either hand- or steam-power, was tried at 40 and 80 revolutions of the handle. At the lower rate this fan did only the work of Phillips's hand fan, at an expenditure of double the power. At double speed the displacement of water was trebled.

Coultas's fan was tried with the water-gauge at 900 and 1080 revolutions. At the first rate, the water-gauge indicated 4·8 inches, and at 1080 revolutions the average pressure was 5·7 inches. With this fan the pressure varied considerably from 5·3 inches to 5·9 inches, but the power required to work it was somewhat excessive for the little engine employed; and the speed was rather irregular. This fan having three inlets, one directly in the rear, and two at the sides, the power required to work the fan with one, two, or three of the inlets open was tested.

The only remaining fan which seems to call for any remark is Greening's (Agricultural and Horticultural Association) No. 1. This was only tried at 40 revolutions per minute, that being in the opinion of the Judges the greatest speed at which this machine could be worked by two men. It is useless to attempt to conceal the fact that the Judges' estimate of the power required by this fan is not borne out by the dynamometer trials, although fully confirmed by the trials in the field, when the representative of the exhibitor was obliged to admit that a third man was required to relieve the two who were at work. The water-gauge showed 1·3 inch of water displaced, and the power required to work it open was ·24-horse-power.

First Trials of Hay Dryers.

Having noticed at some length the various methods and appliances which were entered for competition, and having recorded the trials to which the exhaust fans were subjected by the engineers, it becomes the duty of the Reporting Judge to recount the practical trials by which the Judges attempted to ascertain, not merely the relative merits, but also the economical value and efficiency of the different inventions and expedients which were exhibited.

The action of the Judges has been the subject of some

adverse criticism, of which, however, they do not complain; but it may be said that some of their censors did not make sufficient allowance for the difficulties which must occur in carrying out a series of trials on such an extensive scale. Many of the public, who had been somewhat misled by exaggerated newspaper accounts of what was possible and what had been done, seemed to expect that the whole of the grass would be cut and stacked, and the machines set at work in the course of a single day. Others could not understand how wet weather could interfere with the process which, as they had been led to believe, superseded all need of sunshine or wind at the hay gathering. Some, again, said that all the competitors should have had exactly the same quantity of grass, of exactly the same quality, cut at the same moment, treated in precisely the same way, and delivered to them at the same time, and under conditions in all respects equal and the same. These are conditions which are applicable to experiments carried on in the laboratory and on a very small scale, but they would have been impossible of realization in the present case. What was attempted was the careful observation of the whole process from the first cutting of the grass to the trussing of the hay for market, and the consideration of all the circumstances, advantageous or otherwise, under which each of the competitors had done their work.

The Society had secured for the purpose of these trials about 100 acres of meadow land lying just on the southern outskirts of the town, between the Kennet river and the Holy Brook. Of this 100 acres, about 67 acres, which were part of the Sewage Farm (although they were not irrigated by sewage), were placed at the disposal of the Society by the Reading Urban Sanitary Authority. The remainder was provided by Mr. Colebrook, a very useful and energetic member of the Reading Local Committee. This Committee very liberally undertook to bear half the loss which the Society might sustain by the artificial treatment of this portion of the hay which grew on the Sewage Farm. At a subsequent period 35 acres more standing grass in three adjoining fields was purchased for the Society of Mr. Cundell, who occupies the Coley Park Farm. The Urban Sanitary Authority (the members of which took a great interest in the trials, and did everything in their power to assist the Society) had also reserved for the use of the Society 42 acres of sewage-fed rye-grass, but only a small portion of this was used for a trial of Gibbs's apparatus.

The crop of grass varied exceedingly, both in quantity and quality: 34 acres had been cleared for hay in February, the remainder had been grazed until the middle of May, when it

was cleared for the purpose of providing the Society with hay for these trials. But, independently of this late feeding, the nature of the soil and the character of the herbage differed considerably. In some places a soft woolly grass lay close to the ground, in others a considerable proportion of sharp sedgy grass was found. Here the grass was only a few inches high, there the greater portion was 18 to 24 inches high, while numerous plants of *Festuca elatior* ran up to more than 6 feet in length.* Thus the crop of hay varied in the estimation of the Judges from about 10 cwts. to 50 cwts. per acre.

For the purpose of the trials Messrs. Samuelson and Co. lent six of their Mowing Machines (three of "the Gem" pattern, No. 3803, and three of the "Atlas" pattern, No. 3804 in the Implement Catalogue of the Reading Show). Messrs. Nicholson and Son also lent four of their Hay-makers (patterns 1A and 2, Catalogue Nos. 3413 and 3414), and as many Horse-rakes, pattern 4R (No. 3404). Mr. Champion, manager of the Reading Sewage Farm, provided a number of horses and a large staff of men, and during the whole time of the hay-making gave every sort of assistance. Mr. Sanday, one of the Judges, brought with him thirteen good men, all well used to making hay in the Yorkshire dales. These men, vigorous and lusty fellows, several of them members of Captain Sanday's Volunteer corps, were an invaluable help so long as they could stay. They worked together under the superintendence of Mr. Matthew Brown with a thorough good will, and when they had to leave they were parted with with much regret. Unfortunately they had their home engagements, some of them their own hay-fields, and long before the Reading hay was got up they had to return home. Their way of hay-making being very different to that practised in the Southern counties, a short description of it may not be out of place here. Until the hay had to be pitched up on to the stack they never used a fork, a hand-rake sufficed for every purpose. Following the mowing machine, they raised the swathes by a quick, sharp action of the rake, which was held nearly perpendicularly. Advancing in *échelon* at a rapid pace, they left the hay half turned, half erect, in such a position that the air blew freely through it. Afterwards small foot-cocks were formed by the rake and foot. When these had to be shaken out, the cock was gathered up in the arms and lightly scattered all over the land by the hand. Then, when the hay was to be stacked, wind-rows were made by the rake. Mr. Sanday had also sent some hay-sweeps and sledges, such as are used in the north in place of

* One stem of this grass, which was selected for examination and identification by Mr. Carruthers, the Consulting Botanist to the Society, measured 6 feet 11½ inches.

carts and waggons, and in situations where wheeled vehicles could not be safely used. The hay-sweeps were cradles of slatted woodwork 7 feet wide, resting on the ground in front and rising by an easy curve to 25 inches at the back. The front portion is a strong piece of ash, flat at the bottom and bevelled on the upper edge. The back of the sweep is carried by two solid wooden wheels on a swivel, which enables them to move in any direction. The *modus operandi* with these sweeps is as follows:—The driver stands midway in the width of the sweep and drives along the wind-row; the sweeper drives the hay up and on to the sweep, and in a short time accumulates a large cock, which is swept up to the stack. The draught of this implement is by chains attached to each side of it, and when the stack is reached, the sweep is easily released by unhooking one of the draught chains, and the horse pulling sideways at the other chain disengages the sweep from the hay. The hay-sledges are very similar to those which are used in many parts of the country for moving ploughs and harrows from field to field, only somewhat larger. An open frame-work, 4 feet 6 inches wide and 8 feet 4 inches long, is raised from the ground about 18 inches and rests upon two arms, which lie flat on the ground for a sufficient distance to bear the weight of a load, and in the fore part are curved upwards so as to slide easily along the ground. These sledges were loaded from two wind-rows, one on each side. The hay was placed in position by the Yorkshire men with a rake and one hand, and no loader was required. When the load reached the stack, one side was lifted, and the load being turned over, the sledge was sent back for more. The greater part of the hay was got together by means of these sweeps and sledges,* and when they were no longer required, they were sold to people in the neighbourhood who had seen them in use.

When the Yorkshire contingent left, a large part of the work fell into the hands of "casuals," and it would probably be difficult to find anywhere a more worthless set of vagabonds than were collected in the hay-field. Ignorant of the use of the commonest tools, hopelessly lazy and unwilling to learn, they were never satisfied. To have seen them at work would have tried the temper of a saint, and the only time when the faintest sign of briskness or alacrity was visible was when the beer was served out. On one of the few fine days which shone upon the scene, when the sun was bright and a brisk wind was drying up every drop of moisture, a number of these fellows thought they saw their opportunity, and imagined that even their services could

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* The sweeps and sledges were made by Mr. Joseph Jones, of Preston, near Leyburn.

not be dispensed with. At the dinner hour they came up, headed by a man who, before beginning his work, had inquired very particularly what he was to be paid. He had been told that he would have 3*s*. a day, with an allowance of beer according to the number of hours' work he made. Demanding for himself and his fellows higher wages, he alleged as the ground of his dissatisfaction the rumour that other men, belonging to the regular staff of the Sewage Farm, were getting more money. He was "as good a man as e'er a one o' they." The malcontents were immensely surprised, but not relieved, when they were told that they would be at liberty at the end of the day to go to a better job if they could find one. "Then gie us our money and we'll go." "No; if you go now you will only be paid up to last night. You will get nothing for the broken day." When the Judges returned to the field, after a short absence, they found that there had been a quarrel and a free fight, and the ringleader had left the field adorned with a couple of black eyes, which one of his mates had given him, and he was not seen on the ground again.

Whether it is the custom of the farmers of the neighbourhood to supplement the ordinary wages of the labourers by considerable extra allowances for all sorts of work which require any degree of skill, or whether it arose simply from the desire to make hay while the sun of the Royal Agricultural Society shone upon the Reading district, certain it is that frequent demands were made by the men employed for additional pay. These demands generally took the form of requests for "a shillin' extry" for this or that work as "the usual thing." The stacker thought "there was no harm in arxing a shillin' a stack for stacking." A man who had driven a mowing-machine said he expected "a shillin' an acre" in addition to his wages of three shillings a day, and he tried to persuade the Judges that it didn't come to much money then, as a man could not mow more than 3 acres a day with one pair of horses. When a bargain had been concluded with the thatcher, he put in, as if it were a matter of course, a claim to "a shillin' a rick for beer," which he said was "a reg'lar thing."

On Monday, the 3rd of July, the Judges, having inspected the machines in the Showyard, proceeded to the trial field and inspected the crop of grass before any was mown. In the course of the afternoon and the following morning plots were assigned to the different competitors. In allotting these plots the Stewards and Judges took first those who were first ready. Mr. Coultas, Mr. Champion, and Mr. Phillips for this reason had the first four plots. In determining the size of the different plots, regard was had to the heaviness of the crop, and as far as possible it was sought to give each man about the same

quantity of hay to deal with. The following Table shows (1) the order of the different plots (starting from the bridge near the town); (2) the estimated extent of each allotment; (3) the estimated quantity of hay on each lot.

Number of Plot.	Exhibitors.	Estimated Acreage of Plot.	Estimated Quantity of Hay.
		Acres.	
1	Coultas	12	12
2	Champion (Gibbs's)	5½	10¾
3	Phillips's, Steam-power	6	12
4	Do. Hand-power	5	10
5*	Kite	4	10
6*	Lister	6	14
7*	Greening, Hand-power	8	20
8*	Do. Steam-power	7	
9	Bamlett	14	15

In consequence of the unfavourable weather, Plots 5, 6, 7, and 8 (marked *) were abandoned, so far as trials of the fans were concerned, and the stacks were made up without paying strict regard to the limits of the several plots. In Plot 9, the stacker made his stack larger than was intended, and an extra quantity had to be put into the roof to make it safe.

As the weather from the 3rd to the 24th of July will be frequently referred to, it may be well to draw attention at this point to some trustworthy meteorological observations made in the immediate neighbourhood. By the kindness of Mr. A. W. Parry, Borough Surveyor of Reading, a complete record of observations made at the Forbury Gardens, in the town of Reading, has been obtained and is appended to this Report (p. 720). It will be seen by this Table, that from the 3rd until the 17th of the month some rainfall was registered on every day, and that from the 3rd day, when mowing began, to the 24th, when the last hay-stack was completed, rain fell on 18 days out of the 22. Although the aggregate quantity of rainfall was not large (2·1 in.), it was emphatically a showery period. But the hygrometrical conditions of the atmosphere are all-important as regards hay-making. A heavy rainfall may occur, and the effect of it will quickly disappear if evaporation be rapid. From the 4th to the 22nd—within which period of 19 days the work was really done—there was never more than 6° difference between the readings of the *wet* and *dry* bulb thermometers. The humidity ranged during that period from 67 to 94, complete saturation being represented by 100; the mean degree of humidity for the first 7 days (4th to 10th July) being 72·7, and for the next 7 days (11th to 17th) 78·7. In the column of general observations on the weather of the past 24 hours, 5 days

are marked "wet," 4 "heavy showers," 7 "dull," 1 "cloudy," and 2 "fine."

Not unnaturally, in the opinion of the vast majority of the public, these meteorological conditions, so unfavourable and disastrous to the farmer who had not yet accepted the assistance of science, were a godsend to the exhibitors, who ought to have wished for nothing better than a thoroughly bad hay-time to enable them to show their skill. But if the eulogists of the hay dryers had been a little intemperate, the public were certainly a little unreasonable in their expectations.

The Judges thought it desirable that, in the first trials, the different competitors should as far as possible be consulted as to the management of the hay and the time for stacking it. With complete unanimity the exhibitors declared that they could not deal with *wet grass*. Mr. Champion, on behalf of Gibbs's machine, said: "Give me *half-made hay* and I don't mind its being *water wet*." The exhibitors of fans, on the other hand, said: "We can take *green hay*, if only it is *dry*." The distinction between the two processes is thus very clearly shown. Mr. Gibbs aims at expelling the moisture of the hay, whether natural sap or rain-water. The exhaust fans are designed for the reduction of the high temperature which is the result of fermentation.

On Monday, the 3rd of July, six of Samuelson's mowers were started at 2 P.M., in Plots 1 and 2, assigned to Coultas and Champion. The hay-tedders and the Yorkshire hay-makers followed closely after them. This portion of the meadows had been manured with town-rubbish, of which old boots, sticks, cinders, brick-bats, and broken glass bottles seemed to have been important constituents. Whatever value they might have had as manure, they were disagreeable obstructives to the motion of the mowers. Bystanders from the neighbourhood declared it impossible to cut Plots 2, 3, and 4 with a machine: and that it was useless to attempt it. Certainly the grass was laid close to the ground, and matted together. Considering all these difficulties, very fair work was made; and as all of the machines were sold on the ground, and the purchasers of them were most anxious to remove them before they could be spared, it is clear that their work was approved by some of those who saw it. Though close and dull, the weather on this day and the next was not unpromising,

On Tuesday the 4th, and Wednesday the 5th, the whole of the remaining plots of the first trial were mown; and the tedding was continued whenever the hay was dry on the top; but rain on Tuesday night, and frequent showers during Wednesday, very much interfered with the work. It was im-

possible to get the hay dry enough for putting it in cock. On Thursday there were very heavy showers; and nothing could be done. On Friday, after some showers, the afternoon was bright, and a brisk south-west wind was blowing, and in the evening the foundation of Coultas's stack was begun. On Saturday, the 8th, this stack was nearly completed, and a trial of Gibbs's Hay Dryer was accomplished.

Plot 2.—Mr. Champion, Exhibitor.

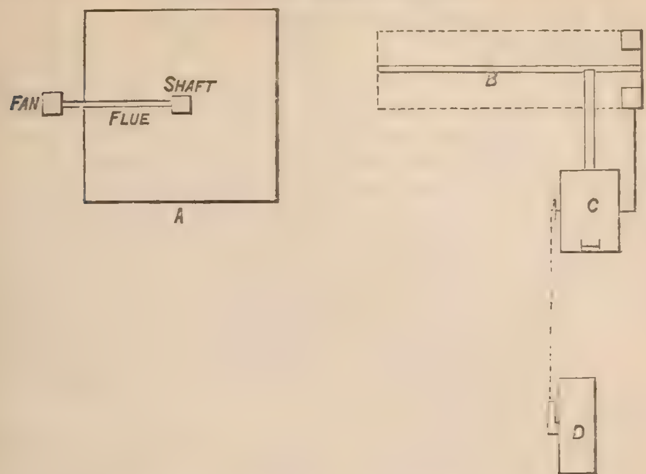
Trial of Gibbs's Hay Dryer, July 8.

As has been stated before, this plot of about 5 acres, with a heavy crop of coarse woolly grass, had been mown on the afternoon of the 3rd and the morning of the 4th. The hay had been several times tedded, and having been much exposed, it had lost a good deal of the sap; but it was by no means dry. The early morning (8th) was fair, and the hay having been wind-rowed, it was carried by a hay-sweep and sledges close up to the drying apparatus, where it was rounded up into fourteen big hay-cocks. This was accomplished in about 2½ hours. The dryer began work at 9.10 A.M., and finished at 3.56 P.M., two short stoppages having been made. The time occupied was thus 6 hours 46 minutes, including stoppages. The stack staddle (Fig. 8, A), 21 feet square, was laid out a short distance to the rear of the dryer (B). In the ground was placed a wooden box-flue, constructed to carry an exhaust fan (as described p. 655); over the inner end of this flue a shaft was carried up by means of a wooden cage 18 inches square and 6 feet high.

The table of the dryer had a fall of about 8 inches in 27 feet length. At right angles to the dryer were placed the furnace and blast fan (C), and in connection with them an 8-horse-power engine (D).

At the the time of starting, the heat of the air-blast, as shown by a pyrometer in the trunk which connects C and B, was 400° F., and during the working it varied from 400° to 475°. In addition to the men employed in bringing the hay to the apparatus and pitching it up to the stack, 8 men were employed as follows:—1 engine-driver, 1 stoker in charge of the furnace, 2 men feeding the machine, 2 removing the hay from the machine, and 2 superintending the work. Of the last-named, one might be dispensed with. The hay being fed into the machine on each side of the central hot-air trough, is carried forward partly by the action of the forks, partly by that of the table, and partly by the action of the hot-air which takes a diagonal direction towards the delivery end of the

Fig. 8.—*Plan showing the Position of the different parts of Gibbs's Hay Dryer, as set for work.*



machine. The passage of the hay from one end of the dryer to the other took from 1½ to 2 minutes. Sometimes a wisp which had been only partially dried was taken back to the feeding end and operated upon again. What was very noticeable in this trial was, that while some of the hay was completely desiccated, so that it smelt like malt, and could be rubbed into powder in the hand, some of it emerged from the dryer quite clammy. Of course this is partly caused by the unequal condition, as regards moisture, of the hay itself; but it is still more due to the great inequality of the temperature at different parts of the dryer. Mr. Anderson made the following observations of the temperature of the air at different points on the outer edge of the table, on the lee and windward sides of the dryer:—

	Lee Side.		Windward Side.	
	Dry Bulb.	Wet Bulb.	Dry Bulb.	Wet Bulb.
Between Forks 3 and 4 ..	111°	105°	97°	89°
,, 6 ,, 7 ..	123	112	101	94
,, 9 ,, 10 ..	123	112	99	88
,, 12 ,, 13 ..	113	96	97	87
,, 15 ,, 16 ..	101	95	98	85
(5) ..	571	520	492	443
Average	114·2	104	98·4	88·6

It will be seen that the average temperature on the sheltered side was 16° higher than that on the windward side; and that the extremes were, with the dry bulb, 97° to 123°; and with the wet bulb, 85° to 112°. The weight of coal consumed by the engine during the trial was 7 cwts.; cost, 5*s.* 7*d.*; and the coke consumed in the furnace was $1\frac{2}{3}$ chaldron; cost, 16*s.* 8*d.* The speed of the hot-air fan was 280 revolutions per minute. During the trial a sharp shower came on; but the greater part of the hay was in large cocks at the time.

The stack thus made never showed any signs of heat, and the Judges are not aware that the fan was ever worked.

On the 11th of September the stack was cut open, and the Judges were surprised and also disappointed to find that the quality of the hay was very inferior. All the sweet malt-like flavour had gone, and what was left was a dead fuzzy substance which the cutting-knife could with difficulty penetrate, and without the faintest scent of hay.

If the hay which was put through Mr. Gibbs's Hay Dryer had been left in the cocks, into which it had been piled before the roasting operation was performed, until the weather was favourable, and if it had then been shaken out for a short time to dry it, a much more valuable stack might have been secured than the one which was the result after using this much vaunted apparatus.

Although the second trial of Gibbs's Hay Dryer occurred later in point of time than the stacking and fanning on other plots of the first trial, it may be well to conclude the account of this machine in this place.

On the 17th of July "Jumbo" and "Alice," and their belongings, were moved down to the Sewage Farm, where about $8\frac{1}{2}$ acres of second-cut rye-grass, grown on irrigated land, was mown on the 15th and 17th. This was tedded by hand on Tuesday, 18th, and Wednesday, 19th, turned over on Thursday, 20th, and on the same day carted into heaps at the homestead, where it remained until Monday, the 24th. By that time some of the heaps had got quite hot. The only difference between the arrangements at this and the former trial was that three men were employed in feeding the machine, and that the hay, after passing through the dryer, was pitched into "Tasker's" elevator, and by it carried up the stack. There seems no reason why the delivery should not be made directly from the dryer into the hopper of the elevator. Beginning at 9.47 A.M., the whole of the rye-grass had been dried by 6.40 P.M., and one hour having been taken out for a trial upon perfectly green grass, and for dinner and other stoppages, the actual time occupied in drying this $8\frac{1}{2}$ acres of grass was about 7 hours. On

this occasion seven men were employed. Seven cwt. of coals were used for the engine, and something less than two chaldrons of coke were consumed in the hot-air furnace. The hay first cured was put into a stack 15 feet square, and, when that was completed, another, of about the same size, was made. In both of these stacks provision was made for a fan being worked if required, wooden flues having been laid down, and shafts constructed. But the stacks never heated enough to require any fanning. It should be noted that this rye-grass had been cut for a week or more, and that the weather had been very much finer than in the earlier trials; but, on the other hand, Mr. Champion, who, as manager of the Sewage Farm, is over-done with rye-grass hay, declared that he had never been able to stack this irrigated grass safely until he had Gibbs's dryer. The farmer of a sewage-farm is probably bound to take so much sewage every day. If he cannot sell his rye-grass green, and get it removed, he must make hay of it and clear his land. The possession of one of these hay-dryers in such a case may be a great assistance, and if the first cost of the apparatus, and the difficulty and expense of removing it, be left out of sight, the operation is not extravagantly costly.

	£	*s.*	*d.*
Seven men at say 3*s.* 6*d.** a day	1	4	6
Coals and Coke, say	1	3	6
	£2	8	0

or less than 6*s.* per acre, excluding use of engine, and wear and tear of machine.

In the course of the day (Monday, 24th) an experiment was tried with some Italian rye-grass which had been cut on the Saturday previous. Twelve cwt. of the green and wet grass was passed twice through the dryer, the delivery end of the table having been raised until the slope was only 5 inches, in order to keep the grass on the table, and under the influence of the hot air for a longer time. It took 20 minutes to pass the whole lot through the first time, and 14 minutes the second time. After this, it still retained a great portion of its sap, and it could not have been stacked up. On weighing it after this partial drying, there remained but $5\frac{1}{4}$ cwt. out of 12: thus $6\frac{3}{4}$ cwt. had disappeared. Of course there was some little waste and litter, but not enough to affect the result appreciably. If this grass had been thoroughly desiccated, or even made into dry hay, it would probably have been reduced to about 3 cwt.—a powerful argument against carting grass in a perfectly green

* It is hot and dry work.

state, even if the machines were more capable of converting grass into hay than they have yet shown themselves to be.

At the Sewage Farm there was plenty of evidence of strong faith in the power of Gibbs's machines. Several hay-stacks had been turned over once or twice, and heaps of stuff, which looked like the blackest of black tobacco or half-dried sea-weed, lay about the premises. The air was filled with a pungent acrid odour, powerful enough to overcome the obnoxious gases of the sewage.

Trials of Exhaust Fans.

Having disposed of the trials of this Hay-dryer, undivided attention may be given to the preparations for and the course of the trials of the Exhaust Fans.

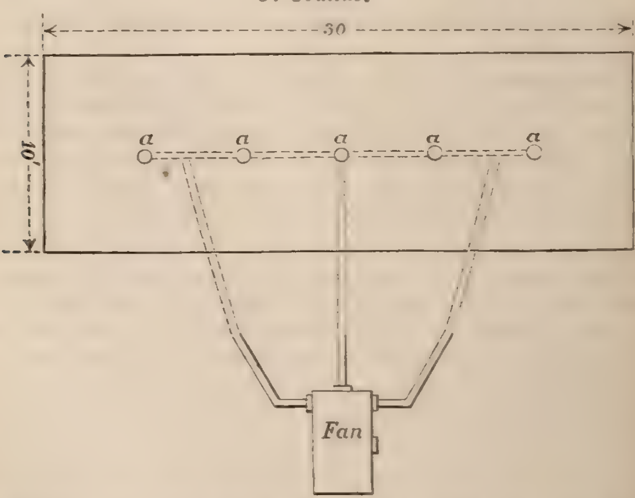
In the following account of the practice and experience of each exhibitor in dealing with the plot of hay allotted to him, the different stacks will be noticed in the order in which the original assignment of ground was made.

Plot I.—J. Coultas.

Fan worked by Steam Power.

As previously stated, the hay for this fan was cut on the 3rd, and the stack was made up on the 7th, 8th, and 10th of July.

Fig. 9.—*Plan of Hay-stack and Fan with Flues, as worked by J. Coultas.*



On Sunday, the 9th, heavy showers fell, and the roof of the stack got rather wet. On the Monday morning the stack was finished, but nearly the whole of the hay in it had been put

together in bad condition. Before commencing the stack, flues of 9-inch socketed drain-pipes had been laid down. The stack-stead was laid out 10 feet by 30 feet, but this size was considerably overrun. A line of pipes had been laid down the centre, with five openings upwards and with three branches converging towards the fan (see *a*, *a*, Fig. 9). These branches were each of them in connection with one of the draught inlets of the fan. These numerous flues were, it is presumed, intended rather to show the means by which a number of stacks could be worked from a stationary fan than to indicate what was required for the cooling of a single stack of the size of the one operated upon. Over each one of the flues was placed a slatted wooden cage, 10 inches square and 8 feet high. In course of time this stack settled down until the eaves were less than 7 feet from the ground, so that the shafts extended up into the roof. By the afternoon of the 9th (Sunday) the temperature on the east had got up to 125°, and on the morning of the 10th to 150°. The upper ends of the five shafts had been covered up by hay; but when the roof was laid out to receive the remainder of the crop, they were uncovered for a little while and the heat rapidly declined to 130°.*

At 4.20 P.M. on Monday the 10th, the fan was started, and it worked for one hour. The engine used was one of eight-horse power, made by the Reading Ironworks Co. Mr. Carey (Assistant-Engineer), who was present throughout the working, reported that not more than four-horse power was exerted. The revolutions of the fan, which worked very regularly, were 1100 per minute. Before the fan started the temperature was

On the North	98°,	on the East	130°,	and on the West	104°.
After one hour's work ..	94°,	„	106°,	„	82°.

The observation on the north was by a thermometer inserted in an iron tube about $4\frac{1}{2}$ feet from the ground; those on the east and west were by spear thermometers, which were thrust into the stack about 5 feet. As there were five shafts in this small stack, it was not very easy to make sure that a thermometer was not too near one of them to give a true indication of the heat. At first the very great variations in temperature which occurred within a short distance disposed the Judges to believe that the

* It has been thought desirable to tabulate the observations of the temperature of the different stacks and the fan workings, and full information on these points will be found in Tables IV. to XV., pp. 704–718. It must be observed that the Judges' notes would have been more copious and more interesting if the public would have allowed the thermometers to remain in the stacks where they were placed. Continually were they pulled out and put in some other place, or perhaps not put in the stack at all. Most of the exhibitors had to complain that they had several thermometers broken or stolen.

thermometers were untrustworthy, or that they were wrongly placed; but further experience led them to believe that such variations did really exist, and for this reason fixed thermometer tubes alone seem scarcely to be depended upon for ascertaining the heat of a stack which is likely to get very hot. For some reason or other the heat in the iron tube on the north side of this stack never rose above 100°, though a spear thermometer inserted very near it showed 105° and 116°, and the Judges were inclined to discredit these tubes.

On the 11th, the day after the first working, the east end of the stack (for some days the hottest part) was 147°; and on the 12th the fan was worked for $1\frac{1}{4}$ hour with the effect of reducing the temperature from an average of 116° (five observations) to that of 79°. The hottest part was brought from 142° to 97°, and the coldest from 82° to 66°.

On the 17th (five days later) one of the thermometers marked 150°, and the fan was set to work for one hour, reducing the average temperature from 134° to 99°. After this, although a temperature of 138° was reached, Mr. Coultas did not think it necessary or desirable to apply the fan, and the stack gradually cooled down. The whole time that the fan was worked on this stack was 3 hours 15 minutes (see Table IV., p. 704).

When the stack was cut open on September 12, the east end and the north and south sides were very mouldy. The cages in the shafts had broken down with the weight of the hay. In the centre of the stack there was some fairly good brown hay. Although the original estimate of the quantity of hay in this stack (viz. 12 tons) was decidedly too low, it only realised 12*l.* 10*s.* It would be absurd to suppose that this represented the true value of the hay, which was worth a good deal more for packing; the probable explanation of the very low prices obtained is that the conditions under which the sale was made were such as to limit competition. It was necessary that the Judges should see all the stacks cut up, and desirable that they should be able to see them all dissected during one week. It was therefore arranged that the sale should be subject to the condition that the purchaser should cut up and truss whatever he bought between the 11th and 16th of September. These remarks apply of course equally to all the stacks which were sold by auction.

Plot III.—C. D. Phillips.

For this Exhibitor's *iron fan* to be worked by *steam-power*, about 6 acres of a heavy crop of coarse grass were allotted. The crop was mown on the 4th, and moved several times, but it was not until the 10th that the stacking began, and on that

day the work was interrupted by heavy showers. The staddle was laid out 20 feet square; and the flue was a galvanised-iron pipe, 8 inches in diameter, laid just in the ground. Over the inner end of this pipe a shaft was made by using a light circular cage 2 feet in diameter, constructed of wooden slats bolted on three iron hoops. The cage was 6 feet high, and as the stack rose it was pulled up until roofing began, when it was taken out and the shaft left without any support. In this respect Mr. Phillips's practice differed from that of all the other exhibitors. Tuesday the 11th, as most visitors to the Show-ground will remember, was a pouring wet day. On Wednesday the 12th the stack was finished, excepting a few loads which were afterwards put in the roof. The hay was a good deal weathered, and it was put together rather wet. In the afternoon of the 14th the temperature on the north side of this stack was 145°. The fan was worked from 3.30 to 4 P.M. by a Ransomes and Head's 1½-horse-power vertical engine, at 2500 revolutions of the fan per minute. The temperature at starting varied from 145° to 65°. After half-an-hour's work the higher temperature was brought to 134°, while on the windward side of the stack the heat remained at 65°. As this hay was undoubtedly wet, Mr. Phillips's representative, Mr. Giles, was not anxious to reduce the heat too much. For a week after the working the temperature of this stack remained at about 140° on the north side, and then the heat shifted to the east. On the 21st the fan was worked for 1 hour 25 minutes, and the heat was brought from 145°, 158° and 127°, to 125°, 125° and 123°. After this, the heat gradually declined, and no further application of the fan was thought necessary. Altogether this fan worked 1 hour 55 minutes (see Table V., p. 705).

This rick when cut up was mouldy almost throughout. In the middle there was a small quantity of brown hay. The stack was sold for 14*l*. 10*s*., there being about twelve tons of it. Taken altogether, it was inferior to Coultas's stack, but it was more weathered before stacking, and the nature of the grass was coarse.

Plot IV.—C. D. Phillips.

Fan worked by *hand-power*. This plot of about 5 acres, like the last, was a heavy crop of coarse hay. It was mown on the 4th, and stacked on the 12th and 13th in bad condition. The stack bottom was laid out for a circular stack 21 feet in diameter. The flue was a square wooden box, 7¾ inches by 10¼ inches and 13 feet long; it was laid with its upper surface level with the ground. Over the inner end a shaft was made, as in the exhibitor's other stack, with a light round cage, which was raised to the required height, and then removed. By the 19th the temperature was up to 154°, and on the 20th the

fan was worked for an hour by two men, who relieved each other at 15 minutes' intervals. The speed maintained was from 45 to 50 turns of the handle per minute, this giving from 585 to 650 revolutions of the fan. The effect of the fan was to reduce the heat from 150° to 104° N., from 112° to 100° S., and from 140° to 112° W. On the 21st the fan was worked again for half an hour, as the temperature had risen again considerably on the N. and W., and at the close of the day the heat was greater at these points than on the evening before, viz. N. 111°, W. 115°. The stack was then left until the 25th, when one hour's work reduced the average from 120° to 97°. On the 26th, the wind being N., the heat on the S. rose to 139°, the fan was worked for 35 minutes, and diminished this to 118°; on the 1st of August another hour's fanning was given, and the stack was then left to itself (see Table VI., p. 706).

When cut open, this rick was very similar to No. 3. Almost the whole of the mass was mouldy. About 10 tons of this musty hay fetched only 13*l.*

Plots V. to VIII.

It has been already intimated that Plots 5, 6, 7, and 8 were, in consequence of the weather, abandoned so far as regards trials. Having been continually tedded and shaken out, the hay had lost all its nature, and when a little fairer weather came, it dried so quickly that there was no chance of its giving any work to a fan or ventilator.

Only one of these stacks, that on Plot 5, was put up to auction; the others, being on the Corporation farm, were taken over by the manager on terms which had been previously arranged. It is worth notice that this hay, the produce of about 4 acres, estimated to weigh about 10 tons, sold for more money than either Champion's stack dried by Gibb's hay-dryer, or Coultas's fanned stack. It must be borne in mind that this hay had lain scattered about the land for a whole fortnight, until it was completely weathered and brown, and that it was only got together when extra hands and teams could be obtained.

For reasons which have been already stated, the sale prices of the hay-stacks cannot be taken to represent the real value of the hay—and indeed, in the absence of any competition, it would be unsafe to rely upon them as evidence of the comparative value of the different stacks—but as some of the exhibitors have taken occasion to glorify themselves on account of the higher prices which their stacks made (without, however, taking into account the quantity of hay in those stacks), it may be worth while to point out that, in so far as the opinion of the public as to the merits of the artificially dried hay was shown, it appeared that they preferred to give a higher price per ton

for the hay upon which the weather had done its worst than for most of the hay which had been experimented upon by the exhibitors (see Table VII., p. 707).

Plot IX.—A. C. Bamlett.

This was a light crop of young grass which, when it had been mown, lay in such thin swathes that a single fine drying day would have made it hay. It was cut on the 5th. Heavy showers came on the 6th, 7th, 8th, 9th and 10th, and the 11th was a pouring wet day. The 12th was fine, and the swathes were horse-raked into wind-rows and stacked immediately. There were some wet and green locks; but if it had not been for thistles, there would not have been much chance of this hay heating. It happened rather unfortunately that the area of the plot, an irregularly shaped one, was somewhat larger than had been expected; and the quantity of hay was large in proportion to that assigned to other competitors. This could easily have been remedied; but the stacker ran his stack over so much, that, in order to get a safe roof, it was necessary to make rather a large stack. As the fan was the smallest and required the least power to work it, this was much to be regretted. The stack was laid out for 18 feet diameter. When it was finished it girthed 87 feet midway between the eaves and the ground. The shaft was formed by a 10-inch square slatted wooden cage 8 feet high. The flue, which was a wooden box 6-inch square (inside measure), with a cast-iron cap to fit immediately on to the fan, was put in the stack when it was about 5 feet high, but it had soon settled down to within 1 foot of the ground. The exhibitor's inexperience, which he fully admitted, was shown by his having made his flue only 10 feet long. As the stack had been carried over the perpendicular, this length did not extend from the shaft to the open air; so the flue was buried, and in order to effect a junction between the fan and the flue it was necessary to cut away the side of the stack. As has been said, the greater part of this hay was stacked on the 12th, a little was added on the 13th, and on the afternoon of that day at 5 o'clock the temperature was 140° on the N.E., and 130° on the N.W.* The fan was worked by 1 man, from 5.40 to 7.40 P.M., the temperature rising all the time. On the next day, the 14th, at 11 A.M. the temperature N.E. was 150°, and N.W. 134°. The fan was then started and worked

* As Mr. Bamlett had not inserted any thermometer tubes, the observations of this stack were made entirely by spear thermometers. This fan being worked more than any other, visitors were more attracted to it, and more interested in its condition. As the stack got solid it required considerable force to drive a spear into it, and thus thermometers were broken, and great difficulty was experienced in getting trustworthy observations.

until evening. A man and a strong lad relieved each other at intervals, and without fatigue kept up 60 turns of the handle, or 1050 revolutions of the fan per minute. From this day the fan was worked for the greater part of each day until the 20th, when only one hour was given. On the 21st and 22nd, 1½ day's work was done, after which the fan was removed to the exhibitor's second stack. By the 27th, however, the heat had risen to 165°, and little impression seemed to be made by working the fan. It seemed probable that the settling of the stack had brought the flue out of connection with the shaft, and the condition of the hay was tested by driving a barbed rod into it, and withdrawing it with a lock of hay in the barb. Although this sample of the interior was brown, it did not give any indication of danger. Later on, before thatching the stack, a hole was bored from the roof downwards by means of Phillips's Stack Borer (Catalogue, No. 5242), and a larger sample of the interior was obtained.* This boring showed that the hay was not near firing-point, and the hole which had been cut was left open for a while to ventilate the stack; the top of the stack, which had settled out of shape, was taken off and shaken out before it was replaced. This ventilating shaft relieved the stack of some of its heat, and the stack began to cool down (see Table VII., p. 707).

When cut, it was found that the cage, which was originally 8 feet high, had been driven into the ground until the top of it was only 4 feet high. On this a thick mat of black and mouldy hay, which was quite impervious to the air, had been formed. Above this the hay had apparently not been influenced by the fan, and while the lower portion of the stack up to and a little above the height of the settled cage was mouldy, the remainder of the stack was fairly good hay rather over-heated. It is a noticeable fact that all that part of the stack which was least affected by the fan was by far the best in quality.

Second Trials of Hay-Dryers.

In order to obtain farther experience of the working powers of the different fans, the Judges had from the outset desired to have the opportunity of putting them to a second trial, in which they might disregard the wishes of the exhibitors, and put the hay together in such condition as to test the fan-system. When all hope of any work on Plots 5, 6, 7, and 8 had to be abandoned, it

* This borer is a steel cylinder about 6 inches diameter, with a pointed corkscrew rod in the axis, which is prolonged beyond the base so as to enter the hay and obtain a hold before the cutting edge of the cylinder touches it. The instrument is worked by two men turning a bar handle which fits on to the central rod of the borer; additional joints for lengthening this rod are supplied, and the whole implement is enclosed in a portable wooden case. Though rather difficult to work, this is a useful tool.

became necessary to obtain an additional quantity of hay; and fortunately the Stewards were able to purchase about 34 acres of standing grass in meadows adjoining those in which the other trials had taken place. This, with the portion of the Urban Sanitary Authorities' ground hitherto unused, made up about 66 acres, which were allotted in the following order:—

No. of Plot.	Exhibitor.	Estimated Acreage of Plot.	Estimated Quantity of Hay.
			Tons.
10	Coultas	9	12
11	Lister	9	13
12	Kite..	6	7
13	Phillips, Hand-power ..	7	9
14	Greening, „ ..	6	9
15	Phillips, Steam-power ..	6	11
16	Bamlett	5	10
17	Greening, Steam-power	17	13

Plot X.—J. Coultas. 2nd Stack.

As there seemed every probability of Coultas being first at liberty, the first allotment was made to him. There was a light crop of grass of fair quality, which was mown on the 14th, and stacked on the 18th and 19th, the first day being fine until the evening. The hay was much of it dry, but some wet locks remained in it; and, as it had not been much moved about, a considerable quantity was decidedly green. The stack was laid out 20 feet in diameter; the flue was constructed, as in the case of the first stack, of 9-inch pipes. In place of the five shafts of the former stack, one cage was used of 22 inches square at the bottom, and tapering to 8 inches square at the top, which was about 9 feet high. In order to make this cage more rigid, the four legs were let into the ground. It was not until the 21st that any heat was shown, but on that day 144° was reached. The fan was worked for a quarter of an hour merely to see whether all was clear; but Mr. Coultas thought it desirable to allow the heat to rise in order to get rid of moisture. On the 25th, 150° was the temperature on the N. and E.; and on the 26th the fan was worked for an hour by the same engine as had been used at the other stack, reducing the temperature from an average of 150° to 116°. No further application of the fan was made, and the heat gradually declined (see Table VIII., p. 708).

When cut up, it was found that the cage in this stack had sunk from 9 feet high to about 6 feet; much of the hay was very mouldy, the upper portion being by far the best. It appeared to the Judges that if this stack had heated more, the hay would have been better.

Plot XI.—R. A. Lister and Co. 2nd Stack.

This plot of 9 acres was, like the adjoining one, of fair quality. Mown on the 14th of July, it was stacked on the 18th and 19th, in very fair condition as regards dryness, but in a rather green state. The stack bottom was 21 feet in diameter, and the flue was formed by a sheet-iron tube lying on the ground. The shaft was formed by a cage 30 inches square at the base, and tapering to about 12 inches square at the top, which was 6 feet from the ground.

On the 20th (the day after the stack was finished) the thermometer showed 140° on the E. side. The fan was worked by two men for one hour, and reduced the heat to 131°. In the evening, however, it was up to 148°. On the 21st, two men worked for twenty minutes, reducing the temperature in that time 25°. On the morning of the 22nd, the thermometer was up again to 146°, and the fan was worked for 1 hour 15 minutes. On the 24th (Monday) one of Ransomes' $1\frac{1}{2}$-horse-power engines was applied, and the fan was run on July 28, 29, 30, 31; and Aug. 2, 3, 4, 5, 7, 8, 9, 10—altogether about 66 hours' working was done. The maximum temperature observed was 168°, on the 10th of August; and after this the heat seemed to decline rapidly. This exhibitor was very badly provided with thermometers, and great difficulty was experienced in getting proper observations (see Table IX., p. 709).

When the stack was opened, it was found that the cage had been broken and crushed down to 4 feet by the pressure of the hay, and the shaft was consequently so small that the air could hardly have made its way through the upper part of the stack; the lower part of the stack was very mouldy, but all the upper portion was pretty good brown hay. This stack, and Coultas's 2nd stack, previously described, were got together under very similar conditions. Of the two, Lister's turned out a better quality of hay than Coultas's.

Plot XII.—C. Kite and Co.

This plot of rather sedgy hay was cut on the 15th and stacked on the 20th of July, in fair order. It will be remembered that this exhibitor attempts to make hay in the stack by ventilation without any mechanical aids. The stack was a circular one, about 21 feet in diameter at the base.

The method adopted was to build a shaft in the centre of the stack, extending from the base to the apex, and capped above the roof with a patent ventilator, such as is applied by the inventor to the ventilation of sewers. The cage which forms and keeps open this shaft is of perforated galvanised iron; communicating with this shaft were two $4\frac{1}{2}$-inch flues of

galvanised iron. These were laid in the same line, radiating E. and W. from the centre. Each was provided with a plug, so that either or both could be used or closed at pleasure. At right angles to these tubes were two others, which, however, did not extend so far inwards as the shaft; they were inserted simply for the purpose of testing the temperature of the stack. A portable slow-combustion stove was used occasionally, and the only other alteration required was attention to the heat of the stack, and the opening or closing of the flues in order to regulate it. On the 23rd the temperature on the N. was 135°, and on the S. 105°; on the 24th the N. had risen to 144°, on the 25th it had sunk to 130°, on the 26th to 118°, and on the 27th to 110°; on the 28th it rose again to 134°, and on the 29th it was 140°, and after some fluctuations 144° was reached on the 10th of August (see Table XV., p. 718).

When the stack was cut, the light galvanised-iron cage had completely collapsed; the water had run down by the side of the ventilating tube, and rotted the hay in places; and the lower part of the stack was mouldy, while the upper part would have been of more value if it had been allowed to heat more. The grass of this field was much of it a sharp-edged sedge, and required heating to make it palatable to animals.

Plot XIII.—C. D. Phillips. 3rd Stack. Hand-power Fan.

The stack from this plot included the produce of about 7 acres, much of it a light crop of sedgy hay, but a portion of the field was of better quality. The grass was cut on the 15th of July, and stacked on the 20th, in very fair order, but still green. In place of the wooden-box flue employed for his second stack, Mr. Phillips used here a sheet-iron tube 8 inches in diameter, as in his 1st and 4th stacks. The shaft was formed in the same way as before, by drawing up a light cage, and removing it at about half the height of the stack. By the 23rd the temperature was N. 145°, E. 138°, S. 88°, W. 75°. On the 24th there was a slight decrease all round, but the fan was worked for half an hour, reducing the highest temperature from 140° to 130°, and the lower temperature of the S. from 70° to 66°, while the W. remained 68°. On the day following, a rise of 15° on the N. and of 18° on the S. occurred before 10·30 A.M., and a further rise of 16° (to 100°) was made on the S. in the course of the day, while the N. remained stationary. The fan was worked for one hour. On the morning of the 26th the temperature was very much equalised throughout, and the fan was worked for half an hour; then, after a stoppage of about three hours, it was worked again for one hour. At the close of the day the average temperature had declined about 13°, but a

comparison of the different readings will show that the heat was shifting, for while N. *fell* 136° to 119°, E. *rose* 136° to 142°, S. *fell* 130° to 90°, and W. *fell* 108° to 104°. Next day (27th) a slight rise took place, and the fan was worked one hour on the 28th, just keeping things *in statu quo*. It will be seen that the object of the exhibitor was not to bring down the heat at once, but to moderate it, and keep it within certain limits. On the 29th the temperature was again over 140°, and the fan was put on for one hour and a half, and after this the heat was never again so great; however, on three other occasions, the fan was worked for a short time (see Table X., p. 711).

This stack, when cut, showed the best hay which up to that time had been met with. One vein of mould marked where some hay had been got too soon after a shower. It must, however, be borne in mind that, with the exception of this small quantity, the hay was in good condition when stacked, and though it was certainly green, the nature of the grass was such that a very little more weather on it would have taken all the goodness out of it. The powerlessness of the fan to *dry* wet hay effectually was significantly shown by the streak of mould which showed the only bit of hay got in damp condition.

Plot XIV.—Agricultural and Horticultural Association. 3rd Stack. Hand-power Fan.*

This was one of the fans which had not yet been used. About 6 acres of a good crop of good hay was assigned to it. The grass was mown on the 19th of July, and early in the morning of the 20th it was shaken out. The weather was hot and brightly sunny, and a very drying wind was blowing; the greater part of the hay was stacked on the same day, and what was left in the field was put into cock in very dry condition. It was, however, so green that the Judges thought the stack must heat, and the occupier of the land declared that he dared not on any account have stacked the hay so early; but, contrary to expectation, it never did get really warm. The grass having been left until rather old, no doubt diminished the liability to heating; and of course the stack was a much smaller one than the farmer would have made; but it is rather difficult to understand why it remained so cool. The stack on the next two plots, which was not secured in such thoroughly dry condition, got hot soon. But the experience of this stack shows how important it is to have hay dry, and that it matters little how green the stuff is if only it be thoroughly crisp and dry. It was not until the 27th, a week after stacking, that the temperature had risen above 120°. On that day the fan was worked for one hour. The

* The two preliminary Trials, on Plots 7 and 8, were abandoned, as explained on p. 678.

heat at starting was 122° E. and 117° W. At the conclusion these temperatures were reduced to 120° and 102°; but a further diminution went on during the night, and at 9.15 A.M. on the 28th, the thermometers marked 110° E. and 100° W. The fan was going for twenty minutes in the middle of the day, and in the evening the temperature was 110° E. and 110° W. By the 9th of August, however, the temperature was reported as 130°, and the fan was again worked for half an hour.

The stack was a circular one, 20 feet in diameter at the base. The flue was a tube of half-round sheet-iron, laid on the ground, and the shaft was an iron tree-guard about 8 feet high.

The fan proved decidedly hard work for two men, and a third had to assist. There was really not the slightest necessity for any fan-working, and no thermometers were required to tell a farmer that it might be left alone (see Table XI., p. 713).

When the stack was cut, the hay proved to be rather dry and scentless, and in the Judges' opinion it would have been better if it had never been interfered with. The estimated weight of this stack was about 9 tons, and it sold for 24*l.* 3*s.*, an improvement in the prices which the hay of the first trials had made; but the grass of this plot and the two next—Phillips's and Bamlett's—was far better in quality than that of the other meadows.

Plot XV.—C. D. Phillips. 4th Stack. Steam-power.

Part of the hay which was stacked for this fan came from the same field as that which made up the one last described, and it had been subjected to exactly the same treatment. The remainder came from an adjoining field, where the grass was of similar quality. This grass was cut on the 19th, and turned, wind-rowed, and cocked in the afternoon of the 20th, but a part of the field was much shaded by trees, and the hay did not make so quickly as in Plot 14. On the 21st the cocks were shaken out, and a portion of it was stacked. Some rain fell in the night of the 21st and the morning of the 22nd, and the hay was not thoroughly dry when stacked. The exhibitor made exactly the same preparations for this stack as for his first. On the 24th the heat had reached 143° N., 148° E., while it was only 64° S. The fan was worked for one hour, the same $1\frac{1}{2}$-horse-power engine being employed as at the other stack, and the temperature at the close of the working at these points was 132° N., 113° E., and 62° S., the average reduction being 15°. Again, on the 26th, one hour's work was given, with the result that an average decline of $17\frac{1}{2}$° occurred. By the 28th, 140° was again observed, and the fan was worked for 40 minutes, reducing the heat about 13° (average); but it will be seen on reference to Table XII., p. 714, that by 4 P.M.

a further decrease had to be recorded. On the 1st of August 140° was again reached, and the fan worked one hour, after which it was not used. Altogether 3 hours 40 minutes fanning was given to this stack, which turned out to be good hay, with very little mould. It realised 19*l.* It is difficult to account for this stack having made less money than the last mentioned, as it was unquestionably much better hay, although it was certainly not stacked in such good condition (see Table XII., p. 714).

Plot XVI.—A. C. Bamlett. 2nd Stack.

This allotment of about 5 acres had a heavy crop of good grass of similar quality to that on Plots 14 and 15. It was, however, more shaded by trees than even Plot 14. The grass was cut on the 19th, turned, wind-rowed, and cocked in the afternoon of the 20th, shaken out on the 21st, and stacked on the 21st and 22nd. Like that of the preceding plot, it had some rain on it in the night of the 21st, and it was not thoroughly dry when stacked. It was, however, so far made that a little delay would, if the weather had been fine, have obviated all need for a fan; while, if more rain had come, the quality would have been injured. The stack was a round one, 20 ft. diameter at the base. The flue was of 6-in. sewage-pipes, laid in the ground with a bend upwards in the centre of the staddle, and over this a shaft was constructed, by means of a wooden cage, as in this exhibitor's first stack.

On the 23rd this stack showed signs of heat, the east side being 135°; and on the 24th the fan was put to work and kept going at intervals during the day; on the 25th it was turned for one hour, and on the 26th, 27th, 28th and 29th, pretty continuously without much change being effected. After this the heat diminished, and it would probably have been better for the hay if no farther working of the fan had taken place, as when the stack was cut, much of the hay was mouldy. This lot sold for 19*l.*, exactly the same sum as Mr. Phillips's stack last described had made; but certainly it was a much dearer bargain than the former rick (see Table XIII., p. 715).

Plot XVII.—Agricultural and Horticultural Association (E. O. Greening). 4th Stack. Power Fan.

This plot, of about 17 acres, was a very light crop of young grass, it having been grazed until late in the spring. It was mown on the 20th, and stacked on the 22nd and 24th. After the crop was mown, it was so thinly scattered over the land that it had to be gathered into windrows by the horse-rakes. Some showers fell on the days when the hay was stacked, and

it was put together green and damp. The stack was a round one, on a 20-foot bottom. The flue was formed with 9-inch socketed earthenware pipes laid in the ground, and the shaft was made by a wooden cage about 6 feet high and 21 inches square.

On the 24th, before the stack was completed, the heat on the N.E. was 132°, and the fan was set to work. The power employed was a 4-horse-power vertical engine, made by Messrs. Hindley, of Bourton (the same engine which had been used for the dynamometer trials). The strap, running from a 30-foot fly-wheel on to a 3-foot pulley, gave a speed of about 1400 revolutions per minute; subsequently this was increased to 1800 revolutions. The fan was worked for one hour and twenty minutes; and again, after an interval of forty minutes, for forty minutes, making in all two hours' work. This had the effect of reducing the average temperature about 23°.

On the 26th the fan was worked for six hours without producing any appreciable effect. As the water which was discharged from the fan was very dirty, one of the Judges suggested to Mr. Greening's representative that perhaps there was a leakage somewhere; and another Judge, putting his hand above one of the joints of the socketed pipes which formed the flue, found a strong indraught of air. This defect was remedied, but on the 27th and 28th, though the fan was worked for five and a quarter hours on the first of these days, and almost throughout the day on the 28th, the temperature on the N. and S.E. continued to rise until, at 4 P.M. on the latter day, the heat had reached 150° and 142° at these two points. The observations of the temperature of this stack were only approximate, as Mr. Greening used some of his "One-and-All" harvest-saving thermometers. In these instruments the niceties of graduation are dispensed with. Mr. Greening, sagely divining that it would be useless to give an ordinary labourer instructions to commence exhausting at so many degrees, and to cease exhausting when the thermometer reached *x* degrees, marks his thermometer on the face of it with express directions: "Commence Exhausting for Hay," "Cease Exhausting," "Firing-point," &c., just as Fahrenheit marked his thermometer with "Freezing" and "Boiling" points,—with perhaps this difference, that the latter based his scale upon accurate observation and experience. The directions given on the "One-and-All" thermometer, with the temperatures at which they are fixed, are believed to be as follows:—"Firing-point," 212°; "Commence Exhausting (Hay)," 120°; "Cease for Hay," "Commence for Corn," 80°; "Cease Exhaust (Corn)," 60°.

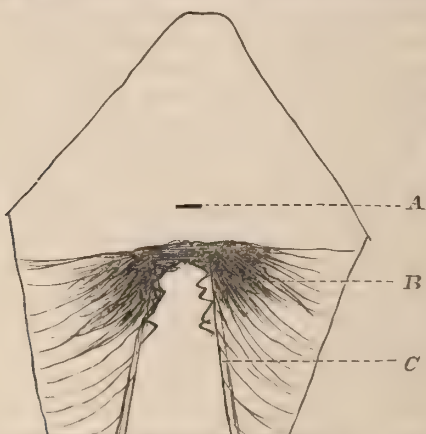
It must be observed that all the other exhibitors of fans had

confessed that they were rather in doubt about the proper time for beginning and leaving off the artificial cooling of stacks; they admitted that they had much to learn on this point, but the ingenious inventor of this thermometer decided the question for himself, and offered the public what they dearly love—be it right or wrong—a positive dogmatic opinion. It has yet to be proved whether these prescriptions will bear the test of experience.

Although the thermometers, which were in the lower part of the stack, did not indicate a temperature exceeding 150°, it was evident to observers, from the smell and appearance of the stack, that some part of it was getting too hot for safety. The roof settled down and required re-making before the stack could be thatched.

On the 1st of August, the Assistant-Steward, who had been left in charge of the field, thought it necessary to intervene. The temperature at the level of the eaves was 200°, and firing-point, according to Mr. Greening, was within a measurable distance. Mr. Box, writing on the 2nd of August, said, "Yesterday morning I found it necessary to take Greening's stack half-way down to get at the *mischief*, and this was above the top of the shaft; upon this the fan had no power; the hay had settled down, and with the settlement had broken the woodwork. I give you a section of the rick (Fig. 10). The hay over the top of the shaft had become hard and thick with mould, and

Fig. 10.—*Section of Stack operated upon by the Fan "One and All"* exhibited by the Agricultural and Horticultural Association.



A.—Thermometer 2 feet above the top of the shaft registered 200° F., after having been inserted one hour.
B.—Thermometer about 120° F. C.—Thermometer about 110° F.

it was impossible for the air to get through. It was like a raw cow-hide."

Nothing could illustrate more forcibly the bad effect of a fixed cage within the shaft than this occurrence. Where such a prop is left in the centre of the stack the hay settles unequally, a portion of the rick is left comparatively open, while another part, which most requires ventilation, is totally impervious to the air. In speaking of the condition of other stacks when opened, this effect of the fixed cage has been already noted and commented upon.

After the reconstruction of the stack, the fan was worked at intervals by a 4-horse-power engine until the 16th of August, and altogether for about 53 hours on 13 different days; the whole period over which this work extended being three weeks (see Table XIV., p. 716).

This stack, which contained about 13 tons of hay, sold for 26*l.* When it was opened the hay was still very warm, and much of it was very black. If it had been left for any length of time it might very probably have fired; some veins of mould appeared, and the whole rick was of very inferior quality.

In the previous account of the different hay-stacks the practice of each exhibitor has been noted, and some details of the temperature which was observed and of the fan-workings have been given. As it is, however, probable that some inquirers may be desirous to obtain more minute particulars of the various modifications of the Neilson system adopted by different exhibitors, and more precise records of the variations of temperature, Tables, which give rather copious information on these points, have been appended to this Report (pp. 703–726).*

It had been the intention of the Judges to give a trial to Mr. Neilson's fan which he had presented to the Society, but the whole of the grass available for the purpose had been used, and there was nothing left but the trimmings from under the trees and other places inaccessible to the mowing-machines. In

* It may be well to remark that, though the records of temperature are true as far as they go, they do not pretend to represent the whole truth. The changes of temperature were so frequent and sudden, and the variations in the heat at different points not far removed from each other were so great, that there is a possibility, nay, a great probability, that in some of the stacks the hottest part was never probed. It was impossible for the Judges to take all the observations, which extended over a period of seven weeks, personally; they were obliged in their absence to delegate some part of this duty to others, but they have every reason to believe that the work was carefully done. The earlier observations, down to the 28th of July, were almost entirely made by the Judges themselves. The figures given are but a few of those recorded; but where the temperature remained stationary, or in some cases where it showed a continuous rise or fall, it did not seem necessary to state the fact.

this, nettles and other weeds were the chief constituents. A small heap of about three tons of this rubbish having been gathered together, Mr. Neilson's fan was attached, and worked once or twice with the view of keeping the stack from destroying itself; but nothing like a trial of the fan was possible, and the circumstance of its having been brought into the field need never have been noticed if it had not been that some of the newspaper correspondents predicted great results, and one of the exhibitors has, in a published letter, compared the price which his stack made with that realised for the stack in question, which is coupled very unfairly with Mr. Neilson's name.

Having completed the history of the haystacks from the mowing of the grass to the trussing up of the hay, it may be convenient to review briefly the results which were arrived at. Fans were applied to 11 stacks, and in only two of these stacks, viz. Nos. 13 and 15 (Mr. Phillips, exhibitor), was there any approach to success. Coultas's big fan attempting to do all the work at a blow, and Bamlett's little one, worked almost continuously, and Lister's, of medium capacity, all produced very similar results, mouldy and inferior hay.* In all the five stacks operated upon by these exhibitors there can be little doubt that the fixed cage had a bad effect; and this was particularly evident in Bamlett's stack, No. 9, and Lister's, No. 11. Mr. Greening's hand-power fan never had anything to do, and it would have been better if it had remained quiet; but this implement might have been weeded out; a *hand*-power machine, which requires three men to keep it at work, is out of the field; the complicated machinery of this implement would easily get out of order, and it would require a skilled mechanic to put it right again. This exhibitor also failed egregiously in his management of the stack to which his power-fan was attached. There remain the two stacks upon which Mr. Phillips operated. The hay which was put into these stacks wanted only a few hours' more exposure to sun or wind to make its condition such that it might have been stacked with safety. If the weather had been threatening, it might have been put into cocks until a favourable opportunity occurred for stacking it. Granted that the method of this exhibitor was the best (and the removal of the cages was a very important feature in his mode of treatment of the stack), and that his hay was the best made, the success was not sufficiently great to induce any one to hurry their hay into the stack in reliance on the power of the fan to

* The number of hours of fan working by these exhibitors was as follows: Coultas's No. 1, $3\frac{1}{4}$ hours; Ditto No. 2, $1\frac{1}{4}$ hour; Bamlett No. 9, 46 hours; Ditto No. 16, 48 hours; Lister No. 11, 66 hours.

keep it clear of damage. It must not be forgotten that these stacks were very small ones (about 9 and 11 tons); had they been three or four times as big, it is more than doubtful whether the hay, if taken in the state in which this was when stacked, could have been successfully treated. If this be the case, the advantage to be gained by the use of the fan is reduced to very small limits indeed.

Upon the much-debated question of what is the proper time to commence and cease fanning, it must be confessed that these trials do not throw any very clear light. It is obvious that the sooner the fan is worked after stacking, the greater is the chance of the air permeating the whole stack equally. When the hay has settled closely, air may be drawn in, but it will enter most freely through the lightest hay, which least requires ventilation. On the other hand, it seems probable that the early application of the fan checks that natural sweating of the hay which is recognised as having a beneficial effect. In almost every case the stack indicated a temperature of 140° or more in some part before the fan was set to work. Mr. Bamlett, in his second trial stack, started before this point was reached, probably in fear that it might get master of his fan, as his first stack seemed likely to do. Mr. Greening, true to his teaching, started his hand-power fan when the highest reading of the thermometer was 122°; and with his steam-power fan he began before his stack was roofed, with a reading of 136°. Mr. Phillips, in his third stack (Plot 13), began at 140°, but was content with half-an-hour's working of a hand-fan. Mr. Coultas's second stack (Plot 10), and Mr. Lister's (Plot 11), were put together under very similar conditions, and there was little difference in the stacks when they were opened; if anything, Lister's had less mouldy hay than Coultas's. The two methods of treatment may be contrasted —neither was very successful.

The conclusion which was forced upon the Judges was that the exhibitors were perfectly right when they said, at starting, that they could not deal with wet hay. But that is exactly what the fans are wanted to do, and what the British public, misled by the newspapers, confidently expected them to accomplish.

It must be borne in mind that Mr. Sutton's prize was offered for the best method of *drying* hay artificially, and the fact that none of the exhibitors of exhaust fans proved that they could *dry* hay at all cannot be too strongly insisted upon.

Trial of Fans on Barley Stacks.

As Mr. Sutton's prize was offered for the best method of drying *hay* or *corn*, the Judges thought it desirable that some

of the fans should be tried upon some description of corn; and it seemed probable that these machines might succeed in drying sheafed corn which had been stacked in bad condition, and in cooling stacks which contained a good deal of green stuff, such as clover and young seeds. In broken weather, farmers are frequently tempted to stack their corn when it is only half dry; and in wet harvests it is almost impossible to secure barley in which clover or seeds have been sown in really good condition, and at such times a great deal of corn is either spoiled in the field, or mow-burnt and seriously injured in the stack. Inasmuch as a large proportion of the material of a corn-stack is dead straw without sufficient sap to make it heat, and as, moreover, a stack of corn when first put together is much more pervious to the air than one of hay, there seemed to be fair grounds for supposing that exhaust-fans would be working under favourable conditions if applied to stacks of corn.

It was not easy to find in the neighbourhood of Reading a suitable field of barley in which seeds or clover had been sown, as the practice of laying down land with a crop of this description is not common. But Mr. Box succeeded in finding a good and bulky crop of barley in a field of about 40 acres, on the Charville farm near Twyford, and in the occupation of Mr. Walter Wiggins, which seemed to meet the requirements of the Judges. The absence of green clover was fully supplied and compensated for, so far as regards these trials, by a plentiful supply of thistles, and a bottom-growth of hop trefoil, which seems indigenous to the soil, and a thick undergrowth of weeds, or what farmers call "trumpery;" and the crop was purchased by the Stewards for the purpose of further trials.

The fans which were selected by the Judges to compete in this trial were those exhibited by Messrs. Coultas, Lister, and Phillips.

On the 9th of August, the barley, which had not ripened so kindly and evenly as had been expected, was thought fit for cutting. It was not dead ripe, and there were some patches of the field which were certainly unripe. Much of the crop was so laid and twisted about, that the cutting was not very easily done. Messrs. Hornsby and Sons were good enough to lend the Society three of their "Indispensable" spring-balance self-raker reapers. The occupier of the farm always cuts his corn by hand, and, living by the side of the highroad from Reading to London, he can always secure a sufficient supply of hands for this tedious work, but he has to pay a high price—as much as 18*s*. an acre being given for "fagging" a crop of wheat, which

would not be considered a heavy one or very bad work in the East of England; it must be added, however, that the "fagging" was beautifully done.

The field was divided into three equal portions, and a reaper was started in each plot on the morning of the 9th. The competitors drew lots for the different shares, and the result was that Mr. Coultas had Plot 1; Mr. Phillips, Plot 2; and Lister and Co., Plot 3.

Immediately following the reaping-machines were a number of "catch" hands, who tied the barley at a pace which was slow even when compared with that of the haymakers in the Fobney meadows. As every farmer in the neighbourhood was engaged in harvest work (though most of them seemed to be proceeding in a rather leisurely way), it was difficult to get a sufficient number of hands to bind the corn as fast as it was wanted for the stack. Some of the labourers who were cutting corn on the farm were willing to work for the Society *at a price;* but as they asked 10*s.* an acre for binding sheaves without any shocking or raking, they were not engaged. The first day was very bright and warm, and a continuance of such weather would have baulked the competitors by leaving them no chance of exhibiting the powers of their fans; but the morning of the 10th was cloudy and threatening; and the thistles and weeds were green and full of sap when the sheaves were bound. Stacking was begun at about 9 o'clock on the morning of the 10th, and pretty well completed on the evening of the 11th.

Before the cutting of the corn began, the exhibitors had made their preparations for the stacks in accordance with the directions they had received. They had been told that each would have to deal with two stacks of about the same size; and they were invited to place their fans in such a position and to lay dampers, or otherwise to make arrangements, so that they could work both stacks at the same time, or each one separately. They were also directed to supply themselves with thermometer tubes, which were to be placed in the stacks pointing to the N., E., S. and W. The Judges directed that these tubes should be made of wood, as they had seen reason to believe that tubes of that material were more trustworthy than those of iron. When the shape of these tubes was under consideration, Mr. Giles (Mr. Phillips's representative), whose readiness and skilfulness were always at the command of both Judges and Exhibitors, and whose good offices it is a pleasure to acknowledge, suggested that a triangular form would be the best, as a box of that shape would be more closely imbedded in the stack than either square or round tubes. If such tubes were placed with the base of the triangle in a horizontal position, the corn must press closely on

every side, and no space would be left between the straw and the tube for a current of air from the outside to interfere with the correct reading of the thermometer inside the tube. Mr. Giles's suggestion was adopted, and it was decided that the tubes should be triangular, measuring inside 3″ at the base, and 1½″ in height. The inner end was to be plugged, and the sides of the tube for about 4 feet from the inner end were to be pierced with holes for the admission of air from the stack. The outer end of the tube was to be provided with a close-fitting plug.

During the trials on hay the Judges had frequently occasion to regret that they had not provided self-registering thermometers, which would have recorded the greatest heat which there had been in a particular spot since the previous inspection. When they were making arrangements for the trials of the fans upon corn which was to be prematurely harvested, it was even more necessary that they should have such instruments, as the range of temperature to which grain can be safely exposed is much more limited than in the case of hay. Leaving out of sight the chemical changes which result from heating corn, and the damage done to grain required for consumption by man or beast, it is sufficiently evident that the germinating power of corn in moist condition may very easily be destroyed by a comparatively small rise of temperature. In the case of barley, any injury to the germinating power greatly decreases the marketable value; and a sample which was potentially of first-class "malting" quality may have been degraded to the rank of "grinding" or "pig-meat" barley by a little haste on the part of the farmer in stacking it, and the consequent heating in the stack.

In reply to some inquiries as to the temperature to which corn in the stack might safely be exposed, the Judges received the following communication from Mr. Carruthers, the Consulting Botanist to the Society:

"The temperature which grains of wheat can endure without being killed has been made the subject of investigation by Sachs. He found that air-dry seeds of wheat heated to 149° Fahr. for an hour, so far retained their vitality that in one experiment 25 per cent. germinated, and in another 98 per cent. But tissues that contain water are more speedily injured by heat than those that are dry. So that seeds of wheat which had been soaked in water were killed at a temperature of 127° Fahr. Seeds exposed to water-vapour would be destroyed at the lower temperature, and also seeds not fully ripe.

"The injury caused by heat is due to the coagulation of the nitrogenous compounds stored up in the embryo and in the

cells containing the starch. These compounds, when the seed begins to germinate, supply the protoplasm, or active living portion of the cells, to the young plants. The life of the nitrogenous compounds is destroyed by coagulation, and though the constituents of the seed may appear on the most careful investigation to be present, this change would entirely destroy the germination.

"It would be dangerous to raise the temperature of corn-stalks to 127° Fahr. For though the coagulation of the nitrogenous compounds may not take place below that point, a considerably lower temperature has an influence on the seed, for the seeds of wheat will not germinate if the temperature is raised to 104° Fahr.

"In the view of those facts, it appears to me that no injury should result to a corn-stack if the temperature is never allowed to exceed 100° Fahr.—W. C."

In order to obtain accurate observations of the heat in the trial corn-stacks, the Judges obtained some self-registering thermometers from Messrs. Negretti and Zambra, and their technical description of these instruments is as follows:—

Negretti and Zambra's Self-Registering Maximum Thermometer for use in Hay Stacks. Price 10*s*. 6*d*.

"This thermometer consists of a tube of mercury with the degrees engraved upon it. Above the mercury the tube is free from air, and just above the bulb is inserted a small piece of glass which acts as a valve. When the mercury has once passed through the valve and has risen in the tube, the upper end of the column registers the maximum temperature. To remove this mercury to the bulb it is necessary to swing the thermometer bulb-end downwards, when the column of mercury in the tube will unite with that in the bulb. The thermometer is inclosed in a sheath of glass so as to protect the division, and the whole is secured into a brass jacket having a slit the whole length of the range of degrees. This jacket is perforated at the bulb, so that the air may have free access to the mercury."

These thermometers were found to answer their purpose, but they are rather fragile, and in the hands of a labourer who has no great nicety of touch they soon come to grief.

In preparation for stacking the barley, circular staddles of 24 feet diameter had been laid out, and the exhibitors had put in their flues, and, where required, damper-boxes.

Mr. Coultas had, as before in the hay trials, laid in the ground glazed and socketed sewage-pipes, 9 inches in diameter and 2 feet long. A bend at each end, rising 6 inches above the ground, connected this flue with the central shaft and the fan. The cost of these pipes was 11*s*. 6*d*. for each stack. The fan was placed between the two stacks, and the side inlets were connected by sheet-iron tubes with the flues. The dampers in the fan case enabled this exhibitor to dispense with damper-

boxes in the ground, as he was able to open or close the communication with either stack by means of the inlet slide. The shaft in these stacks was formed by a wooden cage, 2 feet square at the base, and tapering to 13 inches square at the top. In Stack A the height of this cage was 9 feet 6 inches; in B, for some reason, Mr. Coultas increased the height to 12 feet 6 inches.

Mr. Phillips placed his fan a little in front of the line of stacks, and, consistently with his theory that all angles should be avoided, laid his flues in two curved lines, which started from the stack centres and touched each other just in rear of the fan. These flues were tubes of galvanised iron, 8 inches in diameter, and made in 3-feet lengths, with a tapered edge at one end of each section. In the centres of the stacks, and under the shafts, were damper-boxes of the pattern described at page 658, with one opening only. A rod reaching a little beyond the outside of the stack supplied the means of opening or closing the communication between the flues and shafts. These latter were made, as in the hay-stacks, around light circular cages, which were drawn up to the height desired, and then removed.

Messrs. Lister and Co. put their fan between the two stacks, and ran a continuous flue of sheet-iron, 9 inches in diameter, in a straight line from the centre of one stack to that of another. Midway between the stacks a right-angled junction with the fan was made. In the centre of the stacks square damper-boxes were laid down. It should be noted that in this case the air in its passage from the interior of the stack to the inlet of the fan had its direction changed at a right angle no less than five times—1, at the junction of the shaft and flue; 2, from the flue upwards; 3, horizontally towards the fan; 4, upwards; 5, horizontally into the fan. At least two of these abrupt turns might have been avoided easily; and if the other angles had been rounded off, it is reasonable to suppose that the fan might have proved more effective. The shafts in these stacks were made by circular cages, 7 feet high, 30 inches in diameter at the base, and 18 inches at the top. After the first stack had risen to some little height, an attempt was made to raise this cage; and three or four men were engaged for a while in the hopeless effort to lift themselves and the sheaves on which they were standing, in order to raise the cage.

To return, after these necessary digressions, to the field of work, it must be noted that, although the barley was cut and carted on all three plots simultaneously, one set being at work for each exhibitor, yet there was a considerable difference in the condition of the corn when it was stacked. Mr. Coultas was most lucky, and Messrs. Lister and Co. got by far the largest share of the thistles and "trumpery;" while Mr. Phillips,

more fortunate than the last-named, was not so well in as the first.

As has been said, stacking was begun on the 10th, and on the 11th all the fans were at work on the stacks first made, the highest temperatures observed up to that time being as follows:

Coultas (A), N. 70°. Phillips (A), S. 88°. Lister (A), N. 82°.

On the 12th (Saturday), the other stacks having been completed, each exhibitor worked his fan upon both of his stacks. On the following day (Sunday), Lister only worked, and on Monday morning a considerable rise of temperature had to be recorded all round. The maximum and mean readings were as follows:

August 14.	Coultas.		Phillips.		Lister.	
Stack.	A.	B.	A.	B.	A.	B.
Max.	119°	114°	120°	118°	108°	110°
Mean	$93\frac{3}{4}$	96	$97\frac{1}{4}$	$96\frac{1}{2}$	89	$91\frac{1}{4}$

Some mischievous or ill-disposed person had in the night of Sunday let all the water out of the engine used by Mr. Phillips, and taken away some nuts and bolts, which it took some hours to replace, and before the fan could be got to work the temperature in Stack A had run up to 123°.

In the Tables on pp. 721–726 will be found a full record of the fan-workings, and the morning and evening readings of the thermometers. It is not necessary to repeat here what is there told in minute detail. It will suffice to state that, from the 11th of August until the 11th September, the fans were, except on Sundays, almost constantly at work during the day-time, as will be seen by the following Table:

Aug. 11 to Sept. 11 (32 Days).

Exhibitor.	Stack.	No. of Days on which Fans were Worked.	No. of Hours (approximately) of Fan Working.
Coultas	A	25	$177\frac{3}{4}$
	B	24	$174\frac{3}{4}$
Phillips	A	24	$152\frac{3}{4}$
	B	23	155
Lister and Co.	A	27	$184\frac{1}{2}$
	B	26	224

The power of the fans to reduce the heat of the stacks is evidenced by the difference between the morning and evening observations on days when work had been done, and also by the sudden rise which sometimes occurred after a day when the fans had been idle. The maximum temperature *observed* * in each of the stacks is marked by an asterisk (*) in the Tables, but it may be interesting to place the results side by side for the purpose of comparison:

Exhibitor.	Stack.	Maximum Temperature Observed.	Date of Maximum Observation.	Date of Stacking.
Coultas	A	119	Aug. 14	Aug. 10
	B	114	„ 14	„ 11
Phillips	A	120	Aug. 14	Aug. 10
	B	131	„ 24	„ 11
Lister and Co.	A	120	Aug. 15	Aug. 10
	B	145	„ 24	„ 11

It will be seen that four out of the six stacks developed their greatest heat within three to five days after the stacking; while in the two stacks which heated most, the hottest time (so far as these observations extend) was thirteen days after the corn was put in the stack; and it is perhaps worthy of notice that on this day Coultas's two stacks rose in temperature though the fan was working. There is no doubt that the excessive heat in Phillips's (B) and Lister's (B) stacks was due to the big thistles and the weeds, of which these exhibitors had a large share; but making due allowance for this difference, it would still seem that Mr. Coultas had more command over the temperature of his stacks than either of the other competitors.

On the 11th of September the Judges, having inspected the stacks, came to the conclusion that it was useless to carry on the experiment any farther. Though the fans had been at work for a month, there was evidently a good deal of latent heat; and the fusty smell of the air which was discharged from the fans betrayed the condition of the interiors of the stacks. Orders were therefore given for the threshing of the corn, and Mr. Wiggins, the grower of the barley, who had undertaken the threshing and dressing, promptly made his arrangements, and threshing was begun on the morning of the 12th, Coultas's Stack A being first threshed. This stack had slipped away from the stacker, and one side was only kept up by means of a

* It is quite possible that the heat of the hottest parts of some stacks was never gauged.

number of props—had there been no cage in it, it might have righted itself by the settling down of the opposite side. As it was, the upper part of the north side was kept up, while, below the point where the props were, the sheaves all settled into a position which was nearly vertical, and a cavity, into which a boy might easily have crept, being left open, the air no doubt found its way in there and never penetrated the lower part of the stack. In the upper portion of this stack the corn was bright and uninjured; though few of the sheaves were dry inside; the lower portion, and particularly the north side, was much compressed and the corn was discoloured—the insides of many of the sheaves were almost rotten, and some of the grains had germinated; the cages had tilted over to one side, and the condensed moisture had dripped down from the top of it on to the sides, and some of the barley lying near the cage had grown, and thrown out white shoots 6 or 7 inches long. Stack B was much less injured, but the fan seemed to have had no effect on all the lower part of it. Many of the sheaves were still very wet.

Phillips's stacks were in the upper parts like those of Coultas's. The corn was not much injured, though if the stacks had remained unthreshed it must have moulded; the lower part of Stack B, and particularly the east side for 5 feet above the ground, was pressed as close as millboard, and the grain was heated brown; all the corn in both these stacks had a most disagreeable fusty smell.

Messrs. Lister and Co.'s Stack A had in it some corn which was about on a par with the better parts of the other stacks; but a larger portion of it was damaged, many of the sheaves being very wet, and the lower part heated to a considerable extent. Stack B was in a frightful state, many of the sheaves were completely rotten, and all the south-eastern quarter was reeking like a heap of heated farmyard-manure.

The condition of those corn-stacks, when opened, showed very clearly that the fans had never had any effect upon the lower parts of them. They were so consolidated there that it must have been impossible for the air to penetrate, particularly as it had comparatively ready access through the lighter mass in the upper parts. It did not appear that the fanning had dried the insides of the sheaves in the least degree. Though the temperature had been controlled to some extent, it is probable that in some of the stacks, in that part which lay below the thermometer tubes, a temperature considerably above what was registered had been reached. These tubes were originally put in at about 8 feet from the ground. When the stacks settled,

some of them were not more than 18 inches high, while some were about 36 inches from the ground.

Messrs. Sutton and Sons very kindly gave the use of a large granary, in which the barley could be spread out thinly, and dried and sweetened; and they undertook to put the corn through one of their finishing dressing-machines. They were also good enough to undertake to test the vitality of the grain; and during the threshing of the stacks, samples were frequently taken from the corn as it ran down from the machine, and these were placed in numbered sample-bags, so that each one could be identified with the stack from which it came. These samples were delivered to Messrs. Sutton and Sons, and subsequently Mr. Carruthers was at his request furnished with a portion of each sample. The results of the experiments by Messrs. Sutton are given in Table XXI., at the end of this Report. Mr. Carruthers has not yet completed his experiments.

The trials of the fans upon corn must be considered as having been a complete and disastrous failure. It will be easily conceived that if the Judges had found nothing in the trials upon hay to warrant them in awarding Mr. Sutton's prize, the trials upon corn served only to confirm and strengthen them in the opinions which they had previously formed. The duty of the Judges would have been easier and more pleasant if they could, while declining to give the prize, have given a few words of encouragement to the exhibitors, and intimated that the principles upon which they acted were sound, and that with some modification in detail there was a fair prospect of success in the future; but any such smooth words would misrepresent the opinions which they entertain. Bad and fickle as is this climate, they would far rather take the chances of weather than trust to any of the expedients which have been brought under their notice.

There is a saying current among old-fashioned farmers with regard to corn and hay, "Better to spoil in the field than in the stack." Like most sayings of the kind, it may be read in different ways. One man will take it as an encouragement to a careless waiting upon Providence, while another will despise it as but an expression of old-world distaste for energy and promptitude. The prudent man will, however, accept it as the testimony of accumulated experience to the fact that more injury is done in hay and corn harvest by overhaste than by judicious biding of one's time. The husbandman, waiting with long patience for the fruit of the earth, is no mere figure of speech. Success comes to the man who knows how to wait and when to work. It does not seem very probable that in

the future any of the inventions which have competed for Mr. Martin J. Sutton's prize will greatly change the conditions under which hay and corn crops have to be secured.

Final Report of the Judges.

We, the Judges appointed to test the merits of the different appliances adopted by the competitors for the prize offered by Mr. Martin J. Sutton for "the most efficient and economical method of drying hay or corn crops artificially, either before or after being stacked," report that the undermentioned exhibitors entered into competition for the prize, the different methods adopted being shown by the classification:—

Sub-Class.	Exhibitors.	No. of Article in the Catalogue.	Method adopted.	Time of application of method.
A	W. W. Champion, Reading ..	6094	Hot air: Gibbs' method.	Before stacking.
B	Agricultural and Horticultural Association, Limited, London	4394, 4395	Exhaust Fans, Neilson's system.	In the stack.
B	A. C. Bamlett, Thirsk	4025, 4026		
B	James Coultas, Grantham	2224		
B	W. A. Gibbs, Chingford, Essex	3855, 3856		
B	R. A. Lister and Co., Dursley ..	376		
B	C. D. Phillips, Newport, Mon. ..	5232 to 5244		
C	C. Kite and Co., London	4000	Ventilation assisted by hot air.	In the stack.

A.—Mr. Gibbs' machine, exhibited by Mr. W. W. Champion, was tried on meadow hay and afterwards on sewage rye-grass. In the first trial, which was made under fairly favourable conditions, the exhibitor failed to make hay of as good quality as might have been made in similar weather without any artificial means. The result of the second trial, which was upon sewage rye-grass, was more satisfactory, and we are of opinion that on sewage farms, where rye-grass has to be converted into hay, the machine might be a useful auxiliary, but that, even if the results obtained were more certainly and completely effectual than they have proved to be, the prime cost of the machine would place it beyond the reach of ordinary farmers, while the difficulty of its removal would be a serious obstacle to its general use.

B.—The various adaptations of the Neilson system exhibited have been tried on meadow hay in the stack, and three of the most powerful fans exhibited by Mr. Coultas, Messrs. Lister and Co., and Mr. Phillips, were afterwards tested upon barley stacks. The result, as regards hay, can in no case be considered satisfactory, taking into consideration all the circumstances under which the hay was put together. None of the exhibitors proved that they were able to make good hay in wet weather. In a few instances where fairly good hay was obtained, equally good if not better hay might have been secured without the application of fans. The trials of the three selected fans upon corn were even less satisfactory than those upon hay, none of the machines having succeeded in effectually drying the corn in the stack.

C.—Mr. Kite's system of ventilation in the stack was not successful in its application, nor do we think that it has any practical value.

Under these circumstances we do not feel justified in awarding the prize.

(Signed) MASON COOK.
WILLIAM C. LITTLE.
GEO. H. SANDAY.

September 16.

In the course of this discursive and somewhat prolix Report, opportunities have been taken to record the obligations of the Society to Messrs. Hornsby and Sons, Nicholson and Son, and Samuelson and Co., for the use of various implements; to Messrs. Sutton and Sons, for storing and delivering the barley and testing the vitality of the grain; and to Mr. Champion, manager of the Sewage Farm, for the great assistance which he gave during the trials on hay, by placing at the disposal of the Stewards nearly the whole staff of men and horses engaged on the farm.

The Judges have to thank the Stewards of the Society for the readiness with which they met their somewhat exacting requirements, and to Mr. Box, Assistant Steward, for his indefatigable attention to the work. They cannot conclude without acknowledging the good temper with which the exhibitors bore the strain of these long trials, which, for some of them, extended over ten weeks, during which time the demands upon their patience and forbearance must have been very great.

And finally, the Reporting Judge may be permitted to thank his colleagues for the assistance and counsel which they have given him in the preparation of this Report.

pose of facilitating the comparison of the different methods adopted (p. 703). Table XVI. gives in a summary form the dates of cutting and stacking the Hay, the hours and days of Fan Working, the dimensions of the Stacks, their estimated contents, and the prices realised for such as were sold. In Table XVII. will be found the Meteorological Observations made at Reading during the month of July. The remaining Tables relate to the Barley Stacks.

TRIALS ON HAY.

TABLE III.—Giving PARTICULARS as to FLUES and SHAFTS in STACKS to which EXHAUST FANS were applied.

No. of Stack.	EXHIBITORS.	FLUES.			SHAFTS.		
		Dimensions.	Position.	Material.	Dimensions.	Construction.	REMARKS.
1	Coultas	9″ diam.	In the ground ..	Glazed socketed earthenware pipes.	8′ high, 10″ sq. ..	Wooden slatted cages.	Five shafts in centre line of oblong Stack.
2	Champion ..	8″ × 8″	Ditto	Wooden trunk ..	6′ high, 18″ sq. ..	Ditto	One shaft.
3	Phillips, Steam	8″ diam.	Ditto	Sheet-iron tube ..	2′ diam. to $\frac{2}{3}$ height of stack.	Circular wooden cage raised during progress of stack.	One removed.
4	Phillips, Hand	$10\frac{1}{4}$″ × $7\frac{3}{4}$″ 13 feet long.	Ditto	Wooden trunk ..	Ditto	Ditto	Ditto.
9	Bamlett	10″ long. 6″ × 6″	In the Stack, about 12″ from the ground when settled.	Ditto	8′ high, 10″ × 10″ ..	Slatted wooden cage.	One.
10	Coultas	9″ diam.	In the ground ..	Glazed socketed earthenware pipes.	8′ high, base 22″ × 22″ top 8″ × 8″.	Ditto	One, legs let into the ground.
11	Lister	$9\frac{1}{2}$″ diam.	On the ground ..	Sheet-iron tube ..	6′ high, 30″ sq., at base, tapering.	Ditto	One.
13	Phillips, Hand	8″ diam.	In the ground ..	Ditto	2′ diam. to $\frac{2}{3}$ height of Stack.	Circular wooden cage drawn up.	One removed.
14	Greening ..	11″ to 6″ half round, tapering.	On the ground ..	Ditto	6′ high, 21″ diam.	Iron tree-guard	One.
15	Phillips, Steam	8″ diam.	In the ground ..	Ditto	2′ diam. to $\frac{2}{3}$ height of stack.	Slatted wooden cage.	One removed.
16	Bamlett	6″ diam.	Ditto	Socketed Sewage pipes.	8′ high, 10″ × 10″ ..	Ditto	One.
17	Greening, Steam	9″ diam.	Ditto	Ditto	6′ high, 21″ diam. ..	Wood	One.

TRIALS ON HAY.

TABLES (IV. to XV.) showing the TEMPERATURE observed in different HAY STACKS, the days on which the FANS were WORKED, the NUMBER of HOURS of such WORKING, and the POWER EMPLOYED.

TABLE IV.

COULTAS, JAMES.—(*Catalogue No.* 2224.)

FIRST TRIAL STACK I.

About 12 acres, cut July 3rd. Stacked 7th, 8th, and 9th. Hay, fair quality—light crop—got in bad condition. Dimensions of Stack, 38′ × 17′ × 8′. About 12 tons.

Day.	Time of Observation.	Temperature. N.	Temperature. E.	Temperature. S.	Temperature. W.	Fan Worked.	Observations.
July	h. m.	° "	°	° "	°		
9	4. 0 P.M.	..	125	..	..	..	Shafts closed.
10	7. 0 A.M.	..	150	..	..		
	8.30 ,,	..	130	..	..	..	Shafts open.
	10.30 ,,	94	138				
	4.20 P.M.	98	130	..	104	Fan worked 4.20—5.20 1 hour.	1100 revolutions of fan per min. 4 H.P.
	4.50 ,,	94	125	..	98		
	5.20 ,,	94	106	..	82		
11	9. 0 A.M.	78·105	121	..	82		
	5.50 P.M.	97·116	147				
12	10.20 A.M.	82	142	110 121	124	Fan worked 10.20—11.20 and 11.30—11.45 1¼ hour.	
	10.50 ,,	80	124	92 117	107		
	11.20 ,,	68	105	78 84	85		
	11.45 ,,	66	97	73 75	85		
13	5. 0 P.M.	100	95	..	62		
	10. 0 A.M.						
14	12. 0 Noon	64	..	140			
16	4. 0 P.M.	91	84	..	86		
17	9.30 A.M.	..	110	..	101		
	3. 0 P.M.	·113	132	..	..	Fan 4.0—5.0 1 hour.	
	4. 0 ,,	130·122	150	..	..		
	4.30 ,,	130· 95	140	..	..		
	5. 0 ,,	105· 92	100	..	..		
18	9.30 A.M.	100· 79	98		..		
19	3. 0 P.M.	..	90		..		
25	5. 0 P.M.	138					
27	..	Average 120°					

Table V.

PHILLIPS, C. D.—(*Catalogue No.* 5233.)

First Trial, Stack III.

Fan worked by steam power. Hay about 6 acres—heavy crop of coarse grass—stacked in bad condition. Stack 21′ 6′ × 22 × 9′ 6″. About 12 tons. Hay cut 4th. Stacked 10th and 12th.

Day.	Time of Observation.	Temperature. N.	E.	S.	W.	Fan Worked.	Observations.
July 14	h. m. 3.30 P.M.	° 145	° 118	° 65	° 82	3.30—4.0	1½ H.P.
	3.40 ,,	142	112	..	78		2500 revo-
	3.50 ,,	139	..	..	..	½ hour.	lutions per
	4. 0 ,,	134	112	65	81		minute.
15	6.30 A.M.	140	112	64	88		
	10. 0 ,,	135	90	64	84		
16	..	115					
17	9.30 A.M.	148					
18	9.50 A.M.	142					
	3. 0 P.M.	140	125	..	140		
19	9. 0 A.M.	135	142	..	138		
	3. 0 P.M.	120	118	..	123		
21	8. 5 A.M.	145	158	..	127		
	11.10 ,,	145	144	..	124	11.10—12.15	
	11.25 ,,	..	141	..	124	and	
	11.40 ,,	..	140	..	124	12.30—12.45	
	12.15 ,,	125	125	..	123	1½ hour.	
22	9. 0 A.M.	..	94	..	110		
24	12. 0 Noon	..	102	..	..		
25	9.25 A.M.	..	82	..	99		

Table VI.

PHILLIPS, C. D.—(*Catalogue No.* 5234.)

First Trial, Stack IV.

Fan worked by hand power. Hay about 5 acres—heavy crop of coarse grass—stacked in bad condition. Stack 73′ cir. × 9′ 4″. About 10 tons. Hay cut July 4th—stacked 12th and 13th.

Day.	Time of Observation.	Temperature. N.	Temperature. S.	Temperature. W.	Fan Worked.	Observations.
July 15	h. m. 9.30 A.M.	° 82	° 67	° 100		
16	4. 0 P.M.	131	71			
17	9.30 A.M.	138	114			
18	10. 0 A.M.	132	80			
	2. 0 P.M.	130	84			
19	3. 0 P.M.	154	78			
20	4.40 P.M.	150	112	140	4.40—5.40. 1 hour.	Fan worked by two men relieving one another, 45–20 turns per minute = 585 to 650 revolutions of fan per minute. Heat of discharged air, 130°.
	5.10 ,,	118	105	125		
	5.40 ,,	104	100	112		
21	8.45 A.M.	122	114	144		
	4.30 P.M.	138	72	121	4.30—5.0. ½ hour	Heat of air discharged, 134°.
	4.45 ,,	121	71	120		
	5. 0 ,,	111	70	115		
22	9. 0 A.M.	124	74	102		
24	12. 0 Noon.	136	82	100		
	6. 0 P.M.	134	89	94		
25	9.20 A.M.	130	127	104	9.20—10.20. 1 hour	
	10.20 ,,	92	118	96		
	4.30 P.M.	95	115	82		
26	6.20 A.M.	101	139	104	6.20—6.55. ½ hour.	
	6.55 ,,	84	118	94		
	9.30 ,,	80	116	92		
27	11.30 A.M.	85	134	122		
29	9.45 ,,	110	130	136		
Aug. 1	8. 0 ,,	110	138	130	1 hour.	
2	8. 0 ,,	..	130	125		
3	6. 0 ,,	..	130	120		
	6. 0 P.M.	..	123	118		

Table VII.

BAMLETT, A. C.—(*Catalogue No.* 4025.)

First Trial, Stack IX.

Fan worked by hand power. Hay about 14 acres—a light crop of inferior quality—stacked in damp condition with many green locks. Stack 87′ cir. × 9. About 15 tons. Cut July 5th—stacked 10th and 12th July.

Day.	Time of Observation.	Temperature. N.E.	Temperature. N.W.	Fan Worked.	Observations.
July 13	h. m. 5.40 P.M.	° 140	° 130	P.M. P.M. 5.40—7.40 2 hours.	Worked by 1 man.
	6.10 ,,	140	139		
	6.40 ,,	148	139		
	7.10 ,,	158	138		
14	10.30 A.M.	138	130	From 11.0 A.M. until evening 6 hours.	Man and boy, relieving one another.
	11. 0 ,,	150	134		
	11.30 ,,	152	150		
	12. 0 Noon	155	147		
	4. 0 P.M.	146	140		
15	10. 0 A.M.	140	138	6 hours	Man and boy.
Sun. 16	3.30 P.M.	152	158	1 hour.	
17	8.10 A.M.	150	153	8 hours.	Man and boy.
	12.25 P.M.	153	152		
	2. 0 P.M.	155	..		
	5. 0 ,,	..	151		
18	10.15 A.M.	..	150	8 hours.	
	5. 0 P.M.	138	138		
19	9.30 A.M.	..	160	4 hours.	
	3. 0 P.M.	130	..		
20	9. 0 A.M.	138	..	P.M. P.M. 5.0—6.10 1 hour.	
	3. 0 P.M.	150	150		
	6. 0 ,,	155	147		
21	9. 0 A.M.	146	120	8 hours.	
	4. 0 P.M.	133	131		
22	9. 0 A.M.	148	125	4 hours.	
Sun. 23	3. 0 P.M.	110			
27	10. 0 A.M.	165	..	1 hour.*	

* At this point the fan seemed to have lost all power, and a flue was opened from the top with Phillips's Stack Borer. From this time the temp. declined. On the 2nd of Aug. the maximum was 149°. On the 14th the fan was worked 1 hour, and 140° was never reached again.

Table VIII.

COULTAS, JAMES.—(*Catalogue No.* 2224.)

Second Trial, Stack X.

Hay about 9 acres, of fair quality—stacked in good condition as regards moisture, but some of it very green. Stack 70′ cir. × 11′. About 12 tons. Cut 14th July—stacked 18th and 19th July.

Day.	Time of Observation.	Temperature. N.	E.	S.	W.	Fan Worked.	Observations.
	h. m.	°	°	°	°		
21	9. 0 A.M.	121					
	10.30 ,,	144					
	2. 0 P.M.	143	134				
22	..	144	130			¼ hour.	
23	3. 0 P.M.	..	91	..	75		
24	10. 0 A.M.	140	100				
25	10. 0 A.M.	150	150				
	4. 0 P.M.	150	152				
26	4.30 P.M.	..	152	148	..	4.30—5.30	1040 revolutions per minute discharged air 120°—98°.
	5.30 ,,	..	130	98	..	1 hour.	
29	10. 0 A.M.	134	..	148	142		
	3. 0 P.M.	120	..	144	148		
30	9. 0 A.M.	140	..	120	148		
	6. 0 P.M.	148	..	147	140		
31	11. 0 A.M.	..	..	146	132		
	4. 0 P.M.	120	..	150	120		
Aug.							
1	7. 0 A.M.	140	..	146			
3	10. 0 A.M.	120	..	134			
	5. 0 P.M.	104	..	125			
4	9. 0 A.M.	80	..	125			
10	8. 0 A.M.	133	..	123	132		
	5. 0 P.M.	155	..	..	130		
11	5. 0 P.M.	102	..	..	142		
14	5. 0 ,,	130	..	119			
16	7. 0 A.M.	114	..	100	120		
17	6. 0 P.M.	90	..	110			
19	Morn.	112	..	..	90		

Table IX.

LISTER, R. A. & CO.—(*Catalogue No.* 376.)

Second Trial, Stack XI.

Fan worked by hand or steam power. Hay produce of about 9 acres, of fair quality. Got in good condition, but green. Cut 14th July—stacked 18th and 19th July. Stack 77′ cir. × 10·6. About 13 tons.

Day.	Time of Observation.	Temperature. N.	E.	S.	W.	Fan Worked.	Observations.
July	h. m.	°	°	°	°		
20	9. 0 A.M.	..	140				
	10.45 ,,	..	131	..	..	9.45—10.45. 1 hour.	Fan worked by 2 men.
	6. 0 P.M.	..	148				
21	9. 0 A.M.	..	140	..	..	9.0—9.20. 20 min.	Fan worked by 2 men.
	9.20 ,,	..	115				
	4. 0 P.M.	..	140				
22	9.50 A.M.	..	146				
	10.20 ,,	106	132	..	140	9.50—11.5. 1½ hour.	Fan worked by 2 men
	11. 5 ,,	..	116				
23	3. 0 P.M.	144	136				
24	10. 0 A.M.	..	160	..	..	10.0—10.45. And again in aft. 1½ hour.	By steam, 1½ H. P., 850 rev. per min.
	10.45 ,,	..	140	..	..		
	7. 0 P.M.	..	150	..	..		
	7.10 ,,	130	136	..	..		
25	10. 0 A.M.	118					
	4. 0 P.M.	116					
26	10.15 A.M.	..	90				
27	11. 0 A.M.	..	112				
28	10. 5 A.M.	150	110				
	4. 0 P.M.	158	145	..	..	4.0—4.20. 20 min.	
	4.20 ,,	150	142	134			
29	10.15 A.M.	120	122	..	132	6 hours.	
	3.30 P.M.	..	88	..	132		
30	9. 0 A.M.	90	140	..	138	5 hours.	
	6. 0 P.M.	96	143	..	133		
31	Morn.	81	132	..	140	10 hours.	

TABLE IX.—(*continued.*)

Day.	Time of Observation.	Temperature.				Fan Worked.	Observations.
		N.	E.	S.	W.		
Aug.	h. m.	°	°	°	°		
1	9. 0 A.M.	63	..	..	100		
	6. 0 P.M.	81	..	..	120		
2	11. 0 A.M.	81	..	..	92	6 hours.	Steam.
	7. 0 P.M.	90	..	..	104		
3	10. 0 A.M.	70	..	..	106	3 hours.	,,
	5. 0 P.M.	72	..	..	102		
4	9. 0 A.M.	72	108	..	..	3 hours.	,,
	6. 0 P.M.	80	111				
5	12. 0 Noon.	86	132	..	130	3 hours.	,,
	6. 0 P.M.	..	130	..	102		
7	7. 0 A.M.	160	140	..	134	6 hours.	,,
	7. 0 P.M.	140	120	..	129		
8	6.30 A.M.	150	..	..	142	6 hours.	,,
	6. 0 P.M.	149	140	..	149		
9	7. 0 A.M.	150	148	..	..	10 hours.	,,
	6. 0 P.M.	160	145				
10	7. 0 A.M.	156	168	..	158	4 hours.	By hand.
	7. 0 P.M.	98	90	..	100		
11	6.30 A.M.	100	110	..	112		
	5. 0 P.M.	120	133				
12	7. 0 A.M.	120	114				
	5. 0 P.M.	122	114				
14	8. 0 A.M.	104	119	..	106		
15	7. 0 A.M.	126	..	..	112		
16	7. 0 A.M.	88	..	..	108		
17	7. 0 A.M.	..	127	..	118		
	6. 0 P.M.	116	..	..	114		
19	Morn.	..	120	..	134		
21	Even.	..	115	..	94		

Table X.

PHILLIPS, C. D.—(*Catalogue No.* 5234.)

Second Trial, Stack XIII.

Fan worked by hand power. Hay, the produce of about 7 acres, part coarse and sedgy, part somewhat better—stacked in fairly good condition. Cut 15th July—stacked 20th July. Stack 75′ cir. × 10′. About 9 tons.

Day.	Time of Observation.	Temperature. N.	E.	S.	W.	Fan Worked.	Observations.
July 21	h. m. 3.30 P.M.	° ..	° 115	° ..	° 80		
23	3. 0 ,,	145	138	88	75		
24	9. 0 A.M.	140	..	70	68	9.0—9.30 ½ hour.	Two men relieving each other.
	9.30 ,,	130	..	66	68		
	10.30 ,,	130	139	66	66		
25	10.30 A.M.	145	137	84	82	4.0—5.0. 1 hour.	
	4. 0 P.M.	145	135	100	76		
26	11. 0 A.M.	139	130	130	102		
	1.15 P.M.	136	136	130	108	1.15—1.45.	
	1.45 ,,	125	140	99	102		
	4.50 ,,	124	138	104	108	4.55—5.55.	
	5.30 ,,	119	142	90	104	1½ hour.	
27	11.15 A.M.	129	129	120	120	1 hour.	
28	10.15 A.M.	136	126	120	90		
	3.30 P.M.	137	129	119	89	3.30—4.30. 1 hour.	
	4.30 ,,	133	131	108	83		
29	7. 0 A.M.	143	..	131	101		
	3. 0 P.M.	122	..	90	102	1½ hour.	
30	6. 0 ,,	130	..	134	122		
31	7. 0 A.M.	133	..	132	119		
	6. 0 P.M.	128	..	124	102		
Aug. 1	7. 0 A.M.	139	..	123	89	1 hour.	
	11. 0 ,,	129	..	110	70		
2	8. 0 ,,	128	..	124	78		
	6. 0 P.M.	125	..	110	71		
3	8. 0 A.M.	127	..	83	71		
	6. 0 P.M.	125	..	87	71		

TABLE X.—(*continued.*)

Day.	Time of Observation.	Temperature. N.	Temperature. E.	Temperature. S.	Temperature. W.	Fan Worked.	Observations.
Aug.	h. m.	°	°	°	°		
4	7. 0 A.M.	128	..	96	78	½ hour.	
	5. 0 P.M.	118	..	103	81		
5	7. 0 A.M.	118	..	111	91		
	6. 0 P.M.	117	..	115	97		
6	7. 0 P.M.	129	..	117	112		
7	5. 0 P.M.	130	..	118	100		
8	6.30 A.M.	132	..	..	102	1 hour.	
	7. 0 P.M.	132	..	..	94		
9	9. 0 A.M.	108	..	..	78		
	6. 0 P.M.	126	..	..	100		
10	7. 0 ,,	100	..	..	96		
11	5. 0 ,,	100	..	..	105		
12	5. 0 ,,	101	..	..	112		
14	9. 0 A.M.	128	..	..	130		
15	9. 0 ,,	74	..	..	118		
17	6. 0 P.M.	70	..	..	122		
19	Morn.	116	..	82			
21	Morn.	105	..	68			

Table XI.

THE AGRICULTURAL AND HORTICULTURAL ASSOCIATION (Limited),

E. Owen Greening, *Managing Director.—(Catalogue No.* 4394.)

Second Trial, Stack XIV.

Fan worked by hand power. Hay about 6 acres—good quality—good crop. Stacked dry, but very green. Stack 68′ cir. × 10·6′. About 9 tons. Cut 19th July—stacked 20th and 21st July.

Day.	Time of Observation.	Temperature. N.	Temperature. E.	Temperature. S.	Temperature. W.	Fan Worked.	Observations.
July	h. m. °	°	°	°	°		
25	9.30 A.M.	99	..				
	2. 0 P.M.	104	..	110			
26	4. 0 ,,	106	113	..	114		
27	12. 0 Noon	..	122	..	115		
	4.25 P.M.	..	122	..	117	4.6—5.6.	2 and 3 men.
	5. 6 ,,	..	120	..	102		
28	9.45 A.M.	..	110	..	100	12.0—12.20.	
	4. 0 P.M.	..	110	..	110		
29	11. 0 A.M.	..	104	..	121		
	4. 0 P.M.	..	100	..	130		
31	11. 0 A.M.	..	115	..	119		
Aug.							
1	5.30 P.M.	..	106	..	117		
2	11. 0 A.M.	..	130	..	85		
	6.30 P.M.	..	100	..	75		
3	6. 0 P.M.	..	118	..	74		
4	4.30 ,,	..	128	..	118		
5	10. 0 A.M.	..	115	..	90		
7	7. 0 ,,	..	117	..	120		
8	9. 0 ,,	..	125	..	95		
9	9. 0 ,,	..	130	..	100	½ hour.	
	7. 0 P.M.	..	120	..	100		
10	8. 0 A.M.	..	84	..	120		
11	6. 0 P.M.	..	82	..	120		
15	6. 0 ,,	..	82	..	110		
17	5. 0 ,,	..	98	..	72		

Table XII.

PHILLIPS, C. D.—(*Catalogue No.* 5233.)

Second Trial, Stack XV.

Fan worked by steam power. Hay, the produce of about 6 acres—good quality. Stacked green, but dry—cut 19th July—stacked 21st and 22nd July. Stack 72′ cir. × 10′. About 11 tons.

Day.	Time of Observation.	Temperature. N.	E.	S.	W.	Fan Worked.	Observations.
July	h. m.	°	°	°	°		
23	3. 0 P.M.	136	..	126	70	..	1½ H.P. engine, 2500 revs. of fan per minute. Discharged air, 104°.
24	11. 0 A.M.	142	..	128	..	..	
	12.20 P.M.	145	..	142	64	12.20—1.20. 1 hour.	
	1.20 ,,	132	..	113	62		
	6. 0 ,,	127	..	..	..		
25	9.30 A.M.	120	137	..	65		
	4. 0 P.M.	110	115	..	66		
26	10. 0 A.M.	99	133	134	72		
	11.20 ,,	96	134	134	72	11.20—12.20. 1 hour.	Discharged air, 120°—116°.
	12.20 P.M.	62	123	109	72		
	4. 0 ,,	82	109	..	75		
27	10. 0 A.M.	94	121	117	88		
	4. 0 P.M.	95	127	123	80		
28	9.45 A.M.	108	140	136	104		
	11.55 ,,	104	128	121	86	11.15—11.55. 40 min.	Discharged air, 134°.
	4. 0 P.M.	105	114	119	72		
29	A.M.	112	120	128	91		
	P.M.	110	110	128			
30	P.M.	129	..	122	110		
31	P.M.	134	..	139	124		
Aug.							
1	A.M.	140	..	141	112	1 hour.	
	P.M.	120	..	120	85		
2	A.M.	90	..	130	74		
	P.M.	90	..	120	79		
3	A.M.	111	..	129	71		
4	7. 0 A.M.	129	..	101	72		
	5. 0 P.M.	130	..	72	84		
5	7. 0 A.M.	130	..	72	90		
8	7. 0 A.M.	136	..	78	78		
9	6. 0 P.M.	130	..	84	106		
10	7. 0 A.M.	84	124	..	126		
19	A.M.	103	132	84			
21	A.M.	84	78	122			

Table XIII.

BAMLETT, A. C.—(*Catalogue No.* 4025.)

Second Trial, Stack XVI.

Hand-power Fan. Hay about 5 acres—fair crop—good quality. Stacked green, but tolerably dry. Stack 64′ cir. × 9·6′. About 10 tons. Cut July 19th—stacked 21st and 22nd.

Day.	Time of Observation.	Temperature. N.	Temperature. E.	Temperature. S.	Temperature. W.	Fan Worked.	Observations.
July	h. m.	°	°	°	°		
23	3. 0 P.M.	..	135	..	..		
24	11.30 A.M.	125	136	..	68	6 hours.	One man.
25	..	..	..	..	..	1 hour.	
26	9.45 A.M.	125	..				
	11. 0 ,,	135	136	..	122	8 hours.	
	5.30 P.M.	122	144				
27	4.15 P.M.	130	120	110		4 hours.	
28	A.M.	..	119	141			
	P.M.	..	110	141	..	,,	
29	A.M.	..	110	147	130		
	P.M.	..	110	137	130	,,	
30	P.M.	..	..	140	122		
31	A.M.	..	130	120	130		
	P.M.	..	118	112	120	,,	
Aug.							
1	A.M.	..	124	90	136	8 hours.	
	P.M.	..	133	86	134		
2	A.M.	..	124	76	129		
3	P M.	..	122	69	113		
4	A.M.	111	121	120	80	4 hours.	
	P.M.	..	..	105	75		
5	A.M.	111	121	125	105	2 hours.	
	P.M.	98	120	120	108		
6	A.M.	..	131	124	100	3 hours.	
	P.M.	..	86	104	86		
7	A.M.	..	98	120	100		
9	A.M.	126	84	117	116		
10	P.M.	100	87	120	119		
12	P.M.	116	114	116	113		
19	A.M.	112	112	85	114		
21	A.M.	90	124	100	84		

Table XIV.

AGRICULTURAL and HORTICULTURAL ASSOCIATION (Limited).

Greening, E. O., *Director.*—(*Catalogue No.* 4395.)

Second Trial, Stack XVII.

Fan worked by steam-power. Hay of about 17 acres—light crop of young grass. Mown July 20th—stacked 22nd and 24th—green and damp. Stack 67′ cir. × 12′. About 13 tons.

Day.	Time of Observation.	Temperature. 1* N.	2† N.E.	3* N.E.	4* S.S.	5* S.W.	Fan Worked.	Remarks.
July 24	h. m. 12.30 P.M.	° 104	° ..	° 132	° ..	° ..	2 hours.	
	1. 0 ,,	106	..	138	..	..		
	1.30 ,,	99	..	128			12.30–1.50 and 2.30—3.10.	By Hindley's 4 H.P. vertical engine. 1400 revolutions of fan per minute.
	2. 0 ,,	100	..	120	..	..		
	3.10 ,,	90	..	100				
25	4. 0 P.M.	..	..	100	..	55		
26	11. 0 A.M.	126	124	..	130	98	From 11 A.M. with little intermission until 5.30. 6 hours.	1800 revolutions of fan per minute.
	12.40 P.M.	125	124	..	129	122		
	4.20 ,,	125	125	114	..	121		
	5.27 ,,	123	123	110	129	113		
27	10. 0 A.M.	130	..	118	134	95	10.45—12.15 and 1.45—5.30. 5¾ hours.	
	4.30 P.M.	130	..	118	122	..		
28	10. 0 A.M.	142	105	78	132	70	8 hours.	
	11. 0 ,,	142	110	78	132	67		
	4. 0 P.M.	150	114	80	142	68		
29	10.45 A.M.	110	..	83	136	67	6 hours.	
	4. 0 P.M.	112	..	85	138	78		
31	10.45 A.M.	148	..	124	150	138	..	August 1st spear thermo. put in the roof showed 200°.
	6. 0 P.M.	140	..	85	125	129		
Aug. 1	7. 0 A.M.	112	..	75	105	114	..	Stack top removed and rebuilt.
2	9. 0 ,,	130	..	50	122	105		

* 1, 3, 4 and 5,—3 ft. from the ground. † 2,—At the eaves.

TABLE XIV.—(*continued.*)

Day.	Time of Observation.	Temperature.					Fan Worked.	Remarks.
		1* N.	2 N.E.	3* N.E.	4* S.E.	5* S.W.		
Aug. 3	A.M.	110	..	76	112	132	½ hour.	
	P.M.	110	..	98	98	132		
4	A.M.	108	..	100	110	138		
	P.M.	103	..	115	..	140		
5	A.M.	108	..	130	130	140	3 hours.	
	P.M.	119	..	90	90	110		
7	A.M.	105	..	132	82	120	2 hours.	
	P.M.	104	..	75	80	115		
8	A.M.	115	..	80	85	106		
	P.M.	112	..	80	85	100		
9	A.M.	120	..	108	100	108		
	P.M.	100	..	109	96	106		
10	A.M.	105	..	126	64	110	5 hours.	
	P.M.	104	..	130	64	117		
11	A.M.	103	..	130	74	120	4 hours.	
	P.M.	73	..	98	70	118		
12	A.M.	76	..	101	72	127	5 hours.	
	P.M.	63	..	96	80	120		
13	A.M.	72	..	107	85	110		
	P.M.	90	..	112	90	114		
14	A.M.	128	..	132	..	110	2 hours.	
	P.M.	100	..	110	..	104		
15	A.M.	117	..	124	108	106		
	P.M.	118	..	128	116	110		
16	A.M.	120	..	135	126	120	2½ hours.	
	P.M.	78	..	98	100	113		
17	A.M.	90	..	105	125	118		
	P.M.	98	..	104	132	118		
19	A.M.	122	..	92	102	106		
	P.M.	117	..	80	84	104		

* 1, 3, 4 and 5,—3 ft. from the ground.

Table XV.

KITE, C. & CO.—(*Catalogue No.* 4000.)

Ventilation. Stack No. XII.

About 6 acres—a light crop of rather coarse hay. Stacked in good condition—rather green. Mown 15th July—Stacked 20th July. Stack 66′ cir. × 10½ ft. About 7 tons.

Day.	Time of Observation.	Temperature. N.	E.	S.	Observations.
July		°	°	°	
21	P.M.	112			
22	A.M.	135	..	105	
24	,,	144	62	..	Stove burning.
25	,,	130	70		
26	,,	118	89		
	P.M.	114	95	..	Stove burning.
27	A.M.	110	82		
28	,,	134	75		
29	,,	140	86		
30	P.M.	125	88		
31	,,	132	82		
Aug.					
1	,,	100	81		
2	A.M.	84	80		
3	,,	..	80	102	
	P.M.	..	82	108	
4	,,	..	92	106	
5	,,	..	94	104	
6	,,	..	92	100	
7	,,	..	83	130	Stove burning all day.
8	,,	..	71	90	
9	A.M.	..	71	138	Stove burning all day.
	P.M.	..	96	122	
10	,,	..	60	141	Stove on 6 hours.
11	,,	..	64	144	
12	,,	..	62	136	
14	,,	..	68	118	
15	,,	..	70	140	
16	,,	..	69	130	
17	,,	..	70	118	
21	A.M.	..	68	132	

HAY-DRYING TRIALS.

TABLE XVI.—Showing the DIMENSIONS of the HAY STACKS to which FANS were applied; the DATE of CUTTING and STACKING; the NUMBER of HOURS (approximately) during which the FANS were WORKED, the NUMBER of DAYS on which such WORKINGS took place, the POWER EMPLOYED, and (as regards those STACKS which were publicly sold) the PRICE realised.

Number of Stack.	EXHIBITOR.	1. Grass Cut.	2. Hay Stacked.	3. Number of Hours of Fan Working	4. Number of Days on which Fan Worked.	5. Power Employed.	6. Dimensions of Stacks, 28th July.	7. Esti-mated Contents.	8. Esti-mated Acreage.	9. Price Realised.
		July	July					Tons.		£ s. d.
1	Coultas, J.	3	7-9	$3\frac{1}{4}$	3	Steam, 4 H.P. engine	38′ × 17′ × 8′ ..	12	12	12 10 0
3	Phillips, C. D.	4	10, 12	2	2	Steam, $1\frac{1}{2}$ H.P. ,,	21′·6″ × 22′ × 9′·6″	12	6	14 10 0
4	Ditto	4	12, 13	4	5	Hand, 1 man	73′ diam. × 9′·4″	10	5	13 0 0
9	Bamlett, A. C.	5	10, 12	50	12	,, ,, ...	87′ ,, × 9′·0″	15	14	Not sold.
10	Coultas, J.	14	18, 19	$1\frac{1}{4}$	2	Steam, 4 H.P. ,,	70′ ,, × 11′·0″	12	9	,,
11	Lister and Co.	14	18, 19	66	16	Steam, 4 H.P. ,, Hand, 1 or 2 men	77′ ,, × 10′·6″	13	9	,,
13	Phillips, C. D.	15	20	9	9	Hand, 1 man	75′ ,, × 10′·0″	9	7	,,
14	Greening, E. O. (Agricultural and Horticultural Association)	19	20, 21	2	3	Hand, 2 men	68′ ,, × 10′·6″	9	6	21 3 0
15	Phillips, C. D.	19	21, 22	$3\frac{3}{4}$	4	Steam, $1\frac{1}{2}$ H.P. ,,	72′ ,, × 10′·0″	11	6	19 0 0
16	Bamlett, A. C.	19	21, 22	48	11	Hand, 1 man	64′ ,, × 9′·6″	10	5	19 0 0
17	Greening, E. O. (Agricultural and Horticultural Association)	20	22, 24	51	13	Steam, 4 H.P. ,,	67′ ,, × 12′·0″	13	17	26 0 0

In addition to the above named Stacks two others were sold, viz.:—

2	Champion, W. .. .. (Gibbs's Machine)	3, 4	8	Dried before Stacking	21′ × 21′ × 10′·6″	$10\frac{3}{4}$	$5\frac{1}{2}$	16 10 0
5	Kite	4	19	*No artificial means of drying applied*	22′ × 18′ × 12′·0″	10	4	21 0 0

Extract from CONDITIONS OF SALE.—'The Lots to be cut out and trussed within one week from the day of sale.'

TABLE XVII.—Containing METEOROLOGICAL OBSERVATIONS, taken at FORBURY GARDENS, READING, being 143·38 feet above SEA-LEVEL, at 9 A.M. in the MONTH of JULY, 1882. By ALBERT W. PARRY, Borough Surveyor, &c. Receiving Surface of Rain Gauge 1 foot 5 inches above the ground.

DATE.	BAROMETER.			HYGROMETER.			TEMPERATURE.					RAIN.	WIND.			WEATHER.	
	Uncorrected.	Att. Ther.	Reduced 32° and Sea Level.	Dry Bulb.	Wet Bulb.	Humidity.	Max.	Min.	Mean.	Earth. 1 ft.	Earth. 4 ft.		Direction.	Anemometer. Reading.	Anemometer. Total in Day.	At 9 A.M.	In previous 24 Hours.
	In.	°	In.	°	°	0–100.	°	°	°	°	°	In.			Miles.		
Sat. 1	29·52	67	29·57	62	57	72	72	47	59	62	56	..	N E.	..	52	Fine	Dull.
S. 2	29·91	71	29·94	66	59	64	73	55	64	66	56	..	N.	..	66	Cloudy	Ditto.
M. 3	29·50	73	29·52	68	60	60	75	53	64	66	57	0·01	S.W.	..	114	Ditto	Ditto.
Tu. 4	29·30	65	29·35	60	55	71	63	56	59	66	57	0·10	S.	..	111	Ditto	Ditto.
W. 5	28·97	65	29·02	59	55	76	65	54	59	63	57	0·13	W.	..	154	Showers	Wet.
Th. 6	28·94	64	28·99	60	55	71	62	53	57	61	58	0·18	S.	..	185	Wet..	Showers.
F. 7	28·83	64	28·88	57	54	81	65	51	58	59	58	0·06	S.W.	..	142	Showers	Ditto.
Sat. 8	28·87	68	28·91	61	55	67	66	49	57	59	57	0·10	S.	..	123	Cloudy	Dull.
S. 9	29·02	67	29·06	59	55	73	65	50	57	61	57	0·09	S.W.	..	68	Ditto	Showers.
M. 10	29·15	68	29·19	61	55	67	64	47	55	58	57	0·23	S.W.	..	97	Fine	Dull.
Tu. 11	29·15	58	29·22	55	54	93	64	52	58	59	57	0·23	N.E.	..	167	Wet..	Wet.
W. 12	29·20	68	29·24	62	57	72	70	52	61	59	57	0·05	N.W.	..	113	Fine..	Ditto.
Th. 13	29·33	63	29·37	60	55	71	65	54	59	61	57	0·12	S.	..	155	Cloudy	Showers.
F. 14	29·00	69	29·04	63	59	77	69	56	62	61	57	0·09	S.	..	177	Ditto	Dull.
Sat. 15	29·10	64	29·15	61	60	94	69	59	64	62	57	0·07	S.W.	..	120	Ditto	Ditto.
S. 16	29·02	67	29·06	62	58	77	69	54	61	60	57	0·05	S.W.	..	138	Showers	Ditto.
M. 17	29·20	69	29·24	63	57	67	67	56	61	61	57	0·23	S W.	..	135	Fine..	Ditto.
Tu. 18	29·28	69	29·32	62	57	72	67	55	61	61	57	..	S.	..	173	Cloudy	Wet.
W. 19	29·40	70	29·44	64	58	67	69	53	61	62	58	..	S.	..	127	Ditto	Fine.
Th. 20	29·56	69	29·60	63	57	67	69	48	58	61	58	..	S.	..	95	Fine	Ditto.
F. 21	29·44	67	29·48	61	55	67	68	48	58	62	58	0·03	S E.	..	135	Cloudy	Cloudy.
Sat. 22	29·30	64	29·35	59	58	94	68	56	62	62	58	0·10	S.	..	125	Wet..	Wet.
S. 23	28·93	69	28·97	66	58	69	68	52	60	62	58	..	S W.	..	139	Cloudy	Dull.
M. 24	29·13	67	29·17	62	55	62	67	51	59	60	58	0·24	S.W.	..	81	Fine..	Cloudy.
Tu. 25	29·36	63	29·41	56	54	87	65	51	58	60	58	0·06	S.	..	110	Wet	Showers.
W. 26	29·76	62	29·82	58	54	76	68	51	59	60	58	..	N.	..	65	Cloudy	Ditto.
Th. 27	29·77	72	29·80	66	61	73	72	46	59	61	58	0·02	S W.	..	75	Fine..	Cloudy.
F. 28	29·76	68	29·81	61	58	82	69	55	62	62	58	..	S W.	..	36	Cloudy	Dull.
Sat. 29	29·70	66	29·75	60	59	94	73	53	63	62	58	..	S E.	..	46	Dull..	Fine.
S. 30	29·90	73	29·93	67	62	73	74	53	63	63	58	0·03	N.	..	128	Fine..	Ditto.
M. 31	29·73	67	29·78	60	55	71	71	48	59	63	58	..	E.	..	107	Ditto	Dull.
Sums	..	..	..	..	..	..	..	..	..	..	..	2·27	..	..	..	..	..

EXHAUST FANS.

Trials on Barley Stacks.

Table XVIII.—Showing Records of Temperature and Hours of Fan Workings.

COULTAS, J.—(*Catalogue No.* 2224.)

Date.	Time of Obs.	Stack A. N.	Stack A. E.	Stack A. S.	Stack A. W.	Fan Worked.	Fan Worked.	Stack B. N.	Stack B. E.	Stack B. S.	Stack B. W.
Aug.		°	°	°	°	Hours.	Hours.	°	°	°	°
11	P.M.	70	65	72	..	3½					
12	A.M.	..	70	83	68	9	6	..	75		
	P.M.	71	71	77	77			72	65	65	
13	A.M.	88	83	89	..	Sunday.		82	86		
14	A.M.	119*	110	70	76	8	8	..	114*	78	
	P.M.	69	70	68	68			72	68	68	64
15	A.M.	72	76	68	70	10¾	10¾	70	70	72	68
	P.M.	67	66	61	62			70	64	69	57
16	A.M.	58	67	60	62	3	7½	79	64	72	59
	P.M.	58	60	59	64			64	60	62	59
17	A.M.	60	62	63	65	9	9	67	64	66	62
	P.M.	62	62	62	64			58	64	65	62
18	A.M.	64	68	66	69	6	6	66	68	69	64
	P.M.	68	70	67	70			70	70	70	68
19	A.M.	70	78	72	76	10½	9½	74	74	75	72
	P.M.	63	64	62	64			65	65	66	63
20	P.M.	66	74	68	63	Sunday.		77	82	62	60
21	A.M.	62	82	68	64	9¾	9¾	85	98	62	60
	P.M.	56	60	56	59			71	60	61	56
22	A.M.	56	66	62	56	9	9	75	74	60	52
	P.M.	55	58	57	58			65	61	62	56
23	A.M.	58	63	62	56	7¼	7¼	67	64	56	54
	P.M.	54	56	56	59			65	59	58	58
24	A.M.	56	62	60	56	7	7	62	62	56	52
	P.M.	62	54	56	56			75	60	56	57
25	A.M.	56	69	60	59	5	5	83	82	58	55
	P.M.	60	68	60	62			68	64	60	60
26	A.M.	62	76	66	65	8¾	8¾	86	70	64	62
	P.M.	57	61	60	62			62	62	61	60
27	P.M.	63	73	70	64	Sunday.		64	76	68	59
28	A.M.	64	76	79	72	9	9	74	94	74	62
	P.M.	60	64	62	62			62	64	62	61
29	A.M.	62	76	64	59	..	..	67	79	57	55
	P.M.	56	84	66	68			66	80	62	58
30	A.M.	59	90	70	62	9	9	66	98	63	56
	P.M.	56	62	61	62			61	62	62	58

* Maximum recorded.

TABLE XVIII.—(*continued.*)

Date.	Time of Obs.	Stack A. N.	Stack A. E.	Stack A. S.	Stack A. W.	Fan Worked. Hours.	Fan Worked. Hours.	Stack B. N.	Stack B. E.	Stack B. S.	Stack B. W.
Aug. 31	A.M.	58°	68°	64°	62°	3	3	63°	64°	64°	61°
	P.M.	56	62	58	62			64	61	60	58
Sept. 1	A.M.	60	70	63	64	$5\frac{1}{2}$	$5\frac{1}{2}$	62	71	64	62
	P.M.	63	72	65	66			71	66	66	64
2	A.M.	66	70	64	64	$5\frac{1}{2}$	$5\frac{1}{2}$	71	76	62	62
	P.M.	66	70	62	64			68	66	62	62
3	..	..	..	..	..	Sunday.					
4	A.M.	68	85	66	64	$8\frac{1}{2}$	$8\frac{1}{2}$	75	89	63	62
	P.M.	60	64	64	70			64	64	66	69
5	A.M.	67	70	70	72	$4\frac{3}{4}$	$4\frac{3}{4}$	66	66	70	72
	P.M.	60	60	60	62			65	62	62	60
6	A.M.	58	66	64	64	7	7	65	62	65	62
	P.M.	53	56	60	62			60	59	61	60
7	A.M.	..	51	64	66	8	8	56	58	64	62
	P.M.	56	58	60	64			59	60	63	62
8	A.M.	57	58	64	64	8	8	58	60	66	64
	P.M.	56	57	63	68			59	62	66	64
9	A.M.	59	56	68	67	..	..	59	59	70	66
10	..	..	..	..	..	Sunday.					
11	..	65	62	88	94	3	3	64	62	88	76

EXHAUST FANS.

Trials on Barley Stacks.

Table XIX.

PHILLIPS, C. D.—(*Catalogue No.* 5233.)

Date.	Time of Obs.	Stack A.				Fan Worked.		Stack B.			
		N.	E.	S.	W.			N.	E.	S.	W.
Aug.		°	°	°	°	Hours.	Hours.	°	°	°	°
11	P.M.	72	78	88	80	1					
12	A.M.	81	90	99	81	5	3¾	82	77	82	82
	P.M.	72	72	83	84			78	70	72	77
13	A.M.	89	80	90	91	Sunday.		93	99	70	89
	P.M.	98	98	..	86			92	102	66	92
14	A.M.	120*	107	80	82	7½	7½	101	118	68	99
	P.M.	87	88	68	78			97	77	64	88
15	A.M.	92	98	70	71	7¼	7¼	101	93	67	83
	P.M.	74	74	66	81			69	81	64	68
16	A.M.	90	91	72	75	8½	8½	70	93	62	73
	P.M.	71	70	70	70			59	75	64	67
17	A.M.	87	81	80	83	5½	9½	60	100	73	77
	P.M.	77	77	76	79			61	76	67	69
18	A.M.	84	82	90	90	7	6½	72	98	77	79
	P.M.	80	82	84	88			72	78	72	80
19	A.M.	92	102	92	90	11	11	78	110	78	116
	P.M.	76	78	77	82			70	91	70	73
20	A.M.	94	90	88	82	8	8	70	113	104	85
	P.M.	78	80	68	68			66	95	63	72
21	A.M.	89	91	64	68	6¼	6¼	67	117	61	72
	P.M.	78	66	64	71			60	82	62	60
22	A.M.	93	77	68	70	9	9	60	101	60	59
	P.M.	76	64	60	68			64	78	58	57
23	A.M.	71	70	61	60	..	..	70	100	58	60
	P.M.	78	72	62	60			63	102	56	56
24	A.M.	91	73	61	59	5	5	62	131*	56	58
	P.M.	82	72	56	55			68	100	55	57
25	A.M.	98	78	60	58	4½	4½	70	126	58	58
	P.M.	81	71	59	60			72	100	59	62
26	A.M.	100	80	64	60	7½	7½	75	115	62	65
	P.M.	78	70	68	66			64	90	64	64
27	A.M.	94	76	80	70	..	..	62	98	70	67
	P.M.	100	80	86	73			61	102	71	68
28	A.M.	104	85	99	80	6¾	7¾	65	111	82	76
	P.M.	79	76	73	74			64	90	65	71
29	A.M.	91	84	70	69	..	..	72	105	57	72
	P.M.	91	88	78	75			74	108	66	62

* Maximum recorded.

TABLE XIX.—(*continued.*)

Date.	Time of Obs.	Stack A. N.	Stack A. E.	Stack A. S.	Stack A. W.	Fan Worked.	Fan Worked.	Stack B. N.	Stack B. E.	Stack B. S.	Stack B. W.
Aug.		°	°	°	°	Hours.	Hours.	°	°	°	°
30	A.M.	101	96	89	81	8½	8½	64	113	72	64
	P.M.	74	74	76	74			61	91	72	61
31	A.M.	72	76	81	79	..	..	58	89	84	63
	P.M.	75	76	83	79			59	93	88	64
Sept.											
1	A.M.	83	84	88	80	..	..	67	102	72	76
	P.M.	92	89	77	79			85	108	66	120
2	A.M.	80	94	68	68	5	5	96	128	62	76
	P.M.	83	83	65	62			73	99	63	67
3	A.M.	79	94	64	63	..	..	72	104	59	65
	P.M.	78	93	62	60			69	107	60	63
4	A.M.	98	100	68	63	5½	5½	76	111	63	66
	P.M.	78	79	69	64			71	90	63	68
5	A.M.	82	81	72	68	3½	3½	70	92	67	71
	P.M.	75	72	72	71			65	85	68	70
6	A.M.	78	81	80	78	7	7	68	85	69	79
	P.M.	59	65	70	68			59	77	64	75
7	A.M.	59	66	77	71	6½	6½	56	73	70	85
	P.M.	57	61	72	66			57	72	63	72
8	A.M.	58	62	80	72	6	6	57	74	68	83
	P.M.	58	61	70	63			57	70	64	75
9	A.M.	59	61	73	71	4	4	58	71	69	85
	P.M.	59	61	72	68			59	67	64	73
11	A.M.	62	66	93	92	7	7	65	73	72	114

EXHAUST FANS.

TRIALS ON BARLEY STACKS.

TABLE XX.

LISTER & CO.—(*Catalogue No.* 376.)

Date.	Time of Obs.	Stack A.				Fan Worked.		Stack B.			
		N.	E.	S.	W.			N.	E.	S.	W.
Aug.		°	°	°	°	Hours.	Hours.	°	°	°	°
11	P.M.	82	72	80	80	2½					
12	A.M.	94	..	95	102	8	6	78	..	78	
	P.M.	84	..	83	85			..	73	82	
13	A.M.	..	85	76	100	9	9	102	88	74	
	P.M.	..	..	..	85			85			
14	A.M.	108	..	74	86	11	10	110	92	68	95
	P.M.	86	..	72	74			70	82	70	
15	A.M.	120*	85	68	80	3¼	3¼	86	..	72	74
	P.M.	100	80	79	74			97	72	..	74
16	A.M.	110	108	85	86	4	9	120	105	128	98
	P.M.	79	62	81	83			86	72	92	64
17	A.M.	112	98	90	80	3¾	7	..	98	114	74
	P.M.	113	91	100	104			..	78	103	65
18	A.M.	78	78	83	92	11½	11¼	86	84	118	68
	P.M.	75	90	79	112			79	82	110	68
19	A.M.	105	104	87	113	12	12	118	120	130	82
	P.M.	69	84	80	80			80	84	128	65
20	A.M.	85	104	104	98	10½	10½	120	108	134	82
	P.M.	73	84	68	69			74	92	80	62
21	A.M.	80	89	76	62	6½	12	98	108	108	64
	P.M.	82	90	84	58			80	90	126	56
22	A.M.	80	85	80	56	1	12	80	108	130	58
	P.M.	84	106	72	60			72	98	108	56
23	A.M.	83	84	80	60	4½	4½	84	110	80	60
	P.M.	80	90	82	56			64	108	82	54
24	A.M.	80	96	83	58	10	10	66	145*	74	55
	P.M.	72	94	78	56			..	140	74	56
25	A.M.	77	98	80	59	4½	4½	94	140	90	58
	P.M.	78	98	78	62			125	130	..	60
26	A.M.	83	88	87	64	3½	11	130	117	70	
	P.M.	80	78	75	62			104	106	66	
27	A.M.	94	81	90	60	10	10	115	110		69
	P.M.	82	81	82	61			115	109		65
28	A.M.	82	86	90	70	4½	10½	120	100		70
	P.M.	83	78	67	70			100	66	89	68
29	A.M.	86	78	68	68	..	..	92	98	107	
	P.M.	90	80	78	63			90	96	118	
30	A.M.	95	84	85	..	1½	8½	93	90		
	P.M.	100	82	80	..			98	81	108	62
31	A.M.	116	..	87	92	10	10	112	84	127	67
	P.M.	110	80	82	..			102	84	119	62

* Maximum recorded.

TABLE XX.—(*continued.*)

Date.	Time of Obs.	Stack A. N.	Stack A. E.	Stack A. S.	Stack A. W.	Fan Worked.	Fan Worked.	Stack B. N.	Stack B. E.	Stack B. S.	Stack B. W.
Sept.		°	°	°	°	Hours.	Hours.	°	°	°	°
1	A.M.	118	80	72				100	87	115	121
	P.M.	104	80	69	..	..	..	..	89	100	
2*	A.M.	108	70	70	..	5	5	123	68	62	
	P.M.	98	68	65	..			115	69	65	
3	A.M.	..	65	61	..	..	..	122	65	67	
	P.M.										
4	A.M.	..	68	68	..	10	10	120	70	70	
	P.M.	..	70	72	..			118	70	72	
5	A.M.	..	90	80	..	6	6	120	70	80	
	P.M.	..	75	68	..			106	70	76	
6	A.M.	..	88	86	..	7	7	117	70		
	P.M.	..	74	74	..			100	69	76	
7	A.M.	..	71	80	..	? 8	8	123	95	90	
	P.M.										
8	A.M	..	70	70	..	? 8	8	100	83	99	
9	A.M.	..	64	65	..	9	9	80	92	78	
	P.M.	..	61	62	..			69	73	74	
11	A.M.	..	64	66	..	..	..	84	90	104	

* From this time the observations of the temperature of this exhibitor's stack were irregularly and carelessly taken.

BARLEY STACKS.—VITALITY OF THE GRAIN.

TABLE XXI.—Giving the RESULTS of TRIALS by Messrs. SUTTON and SONS, READING, of SAMPLES taken from the different STACKS to which EXHAUST FANS had been applied.

EXHIBITOR.	Stack.	Sample No.	Number of Grains which had shot up above Ground. 5 Days after Sowing.	6 Days	7 Days	8 Days	9 Days	Percentage of Total Number which Germinated.	Average Vitality (per cent.) of all Samples from each Stack.
Coultas, J. ..	A.	1	44	46	46	46	46	92	80
		2	45	48	48	48	48	96	
		3	41	45	45	45	45	90	
		4	34	38	39	39	39	78	
		5	13	18	19	19	19	38	
		6	39	43	43	43	43	86	
Ditto	B.	7	45	47	49	49	49	98	89
		8	43	46	46	46	46	92	
		9	41	41	42	42	42	84	
		10	45	46	46	46	46	92	
		11	44	47	50	50	50	100	
		12	32	34	34	34	34	68	

TABLE XXI.—(*continued.*)

Exhibitor.	Stack.	Sample No.	Number of Grains which had shot up above Ground.					Per-centage of Total Number which Germinated.	Average Vitality (per cent.) of all Samples from each Stack.
			4 Days after Sowing.	5 Days	6 Days	7 Days	8 Days		
Phillips, C. D.	B.	13	20	42	49	49	49	98	48·33
		14	10	26	28	28	29	58	
		15	17	32	33	34	34	68	
		16	19	24	24	24	24	48	
		17	1	1	1	1	1	2	
		18	7	7	8	8	8	16	
			4 Days after Sowing.	5 Days	6 Days	7 Days	9 Days		
Ditto	A.	19	23	29	35	38	40	80	60·66
		20	31	36	36	37	37	74	
		21	28	31	33	33	33	66	
		22	35	40	40	40	42	84	
		23	19	23	25	25	25	50	
		24	0	4	5	5	5	10	
			5 Days after Sowing.	6 Days	7 Days	8 Days	9 Days		
Lister and Co.	A.	27	30	32	33	34	34	68	48·57
		28	36	40	41	43	43	86	
		29	41	13	45	45	45	90	
		30	38	39	40	40	40	80	
		31	2	3	3	3	3	6	
		32	2	2	2	2	2	4	
		33	2	3	3	3	3	6	
Ditto	B.	34	44	48	48	48	48	96	46·57
		35	45	45	45	45	45	90	
		36	39	41	42	42	43	86	
		37	2	2	2	2	2	4	
		38	1	1	1	1	1	2	
		39	22	23	23	24	24	48	
		40	0	0	0	0	0	0	

NOTE.—For the purpose of these trials samples were taken at intervals from the corn as it ran down from the threshing-machine, and these were placed in numbered bags, which were delivered by the Judges to Messrs. Sutton and Sons, who tested the samples by sowing 50 grains out of each of them in their trial house. Sample 17 was not, however, passed through the threshing-machine. It was rubbed out by hand from some sheaves which lay around a thermometer-tube in which a temperature of 131° had been registered.

TRIALS ON BARLEY STACKS.

TABLE XXII.—Showing the MEAN TEMPERATURE of Messrs. COULTAS'S and PHILLIPS'S STACKS, MORNING and EVENING, on those days when their FANS were at Work, with the INCREASE or DECREASE of TEMPERATURE in the EVENING as compared with that of the MORNING of the same day.

COULTAS, J.							PHILLIPS, C. D.						
STACK A.				STACK B.			STACK A.				STACK B.		
Temperature, Mean of Observations.		Increase (+), or Decrease (−), P.M. compared with A.M.	Days on which Fan Worked.	Temperature, Mean of Observations.		Increase (+), or Decrease (−), P.M. compared with A.M.	Temperature, Mean of Observations.		Increase (+), or Decrease (−), P.M. compared with A.M.	Days on which Fan Worked.	Temperature, Mean of Observations.		Increase (+), or Decrease (−), P.M. compared with A.M.
A.M.	P.M.			A.M.	P.M.		A.M.	P.M.			A.M.	P.M.	
° 74	° 74	° ..	Aug. 12	° ..	° ..	° ..	° 88¼	° 77¾	° −10½	Aug. 12	° 80¾	° 74¼	° − 6½
93¾	68¾	−25	14	96	68	−28	97¼	80¼	−17	14	96½	81½	−15
71½	64	− 7½	15	70	65	− 5	82¾	73¾	− 9	15	86	70½	− 5½
61¾	60¼	− 1½	16	68½	61¼	− 7¼	82	70¼	−11¾	16	74½	66¼	− 8¼
62½	62½	..	17	64¾	62¼	− 2½	82¾	77¼	− 5½	17	77½	68¼	− 9¼
66¾	68¾	+ 2	18	66¾	69½	+ 2¾	86½	83½	− 3	18	81½	75½	− 6
74	63¼	−10¾	19	73¾	64¾	− 9	94	78¼	−15¾	19	95½	76	−19½
..	..	..	..	..	..	..	88½	73½	−15	20	93	74	−19
69	57¾	−11¼	21	91¼	62	−29¼	79¼	69¾	− 9½	21	79¼	66	−13¼
60	57	− 3	22	65¼	61	− 4¼	77	67	−10	22	70	64¼	− 5¾
57¼	56¼	− 1	23	60¼	60	− 0¼	..	..	..	23	..	..	..
58½	59½	+ 1	24	58	62	+ 4	71	66¼	− 4¾	24	76¾	70	− 6¾
61	62½	+ 1½	25	69½	63	− 6½	73½	67¾	− 5¾	25	78	73¼	− 4¾
67¼	60	− 7¼	26	70½	61¼	− 9¼	76	71	− 5	26	79¼	70½	− 8¾
72¾	62	−10¾	28	76	62¼	−13¾	92	75½	−16½	28	83½	72½	−11
65¼	68½	+ 3¼	29	64½	66½	+ 2	..	..	..	29	..	..	..
70	60	−10	30	70¾	60¾	−10	91¾	74½	−17¼	30	78¼	71¼	− 7
63	59½	− 3½	31	63	60¾	− 2¼	..	..	..	31	..	..	..
64¼	66½	+ 2¼	Sept. 1	64¾	66¾	+ 2	..	..	..	Sept. 1	..	..	..
66	65½	− 0½	2	67¾	64½	− 3¼	77½	73	− 4½	2	90½	75½	−15
70¾	64½	− 6¼	4	71¾	65¾	− 6	82¼	72½	− 9¾	4	77½	73	− 4½
69¾	62	− 7¾	5	68½	62¼	− 6¼	75¾	72½	− 3¼	5	75	72	− 3
63	57¾	− 5¼	6	63½	60	− 3½	79¼	65½	−13¾	6	74¾	68¾	− 6
[illegible]	59½	− 0¼	7	60	61	+ 1	68¼	64	− 4¼	7	71	66	− 5
[illegible]	61	+ 0½	8	62	62¾	+ 0¾	68	63	− 5	8	70½	66½	− 4

Royal Agricultural Society of England.

1882.

President.

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1882 EMLYN, Viscount, M.P., *Golden Grove, Carmarthen, S. Wales.*
1873 EVANS, JOHN, *Uffington, Shrewsbury, Salop.*
1876 FEVERSHAM, Earl of, *Duncombe Park, Helmsley, Yorkshire.*
1879 FOSTER, SAMUEL P., *Killhow, Carlisle, Cumberland.*
1875 FRANKISH, WILLIAM, *Limber Magna, Ulceby, Lincolnshire.*
1881 GILBEY, WALTER, *Elsenham Hall, Essex.*

Year when Elected.	
1879	Gorringe, Hugh, *Kingston-by-Sea, Brighton, Sussex.*
1874	Hemsley, John, *Shelton, Newark, Notts.*
1876	Howard, Charles, *Biddenham, Bedford.*
1878	Howard, James, M.P., *Clapham Park, Bedfordshire.*
1871	Jones, J. Bowen, *Ensdon House, Montford Bridge, R.S.O., Salop.*
1869	Leeds, Robert, *Keswick Old Hall, Norwich.*
1874	Lindsay, Colonel Sir R. Loyd, M.P., *Lockinge Park, Wantage, Berkshire.*
1881	Little, Herbert J., *Coldham Hall, Wisbech, Cambs.*
1865	Lopes, Sir Massey, Bart., M.P., *Maristow, Roborough, Devon.*
1874	Martin, Joseph, *Highfield House, Littleport, Isle of Ely, Cambridgeshire.*
1880	Moreton, Lord, M.P., *Tortworth Court, Falfield, R.S.O., Gloucestershire.*
1879	Neville, Robert, *Butleigh Court, Glastonbury, Somersetshire.*
1857	Pain, Thomas, *Audley's Wood, Basingstoke, Hants.*
1881	Parker, Hon. Cecil T., *Eccleston, Chester.*
1861	Randell, Charles, *Chadbury, Evesham, Worcestershire.*
1875	Ransome, Robert Charles, *Ipswich, Suffolk.*
1867	Ravensworth, Earl of, *Ravensworth Castle, Durham.*
1871	Rawlence, James, *Bulbridge, Wilton, Salisbury, Wilts.*
1869	Ridley, Sir M. White, Bart., M.P., *Blagdon, Cramlington, Northumberland.*
1875	Russell, Robert, *Horton Court Lodge, Dartford, Kent.*
1874	Sanday, George Henry, *Wensley House, Bedale, Yorkshire.*
1878	Sheraton, William, *Broom House, Ellesmere, Salop.*
1856	Shuttleworth, Joseph, *Hartsholme Hall, Lincoln.*
1874	Spencer, Earl, K.G., *Althorp, Northampton.*
1882	Stafford, Marquis of, M.P., *Trentham Hall, Stoke-upon-Trent, Staffs.*
1875	Stratton, Richard, *The Duffryn, Newport, Monmouthshire.*
1881	Thorold, Sir John H., Bart., *Syston Park, Grantham, Lincolnshire.*
1874	Turbervill, Lieut.-Col. Picton, *Ewenny Priory, Bridgend, South Wales.*
1845	Turner, George, *Great Bowley, Tiverton, Exeter, Devonshire.*
1871	Turner, Jabez, *Norman Cross, Huntingdonshire.*
1871	Wakefield, William H., *Sedgwick, Kendal, Westmoreland.*
1882	Warren, Reginald Augustus, *Preston Place, Arundel, Sussex.*
1870	Whitehead, Charles, *Barming House, Maidstone, Kent.*
1865	Wilson, Jacob, *Chillingham Barns, Alnwick, Northumberland.*
1878	Wise, George, *Woodcote, Warwick.*

Secretary and Editor.

H. M. JENKINS, 12, *Hanover Square, London*, W.

Consulting Chemist—Dr. Augustus Voelcker, F.R.S., 12, *Hanover Square*, W.
Consulting Botanist—W. Carruthers, F.R.S., F.L.S., *Central House, Central Hill, Norwood*, S.E.
Consulting Veterinary Surgeon—Professor James Beart Simonds, *St. John's Villa, Ryde, Isle of Wight.*
Honorary Consulting Entomologist.—Miss E. A. Ormerod, *Dunster Lodge, Spring Grove, Isleworth.*
Veterinary Inspectors—The Officers of the Royal Veterinary College.
Consulting Engineer—W. Anderson, 3, *Whitehall Place*, S.W.
Surveyor and Superintendent of Works—Wilson Bennison, *Ryeston, Spring Grove Place, Bedford.*
Consulting Surveyor—George Hunt, *Evesham, Worcestershire.*
Seedsmen—Thomas Gibbs and Co., *Down Street, Piccadilly*, W.
Publisher—John Murray, 50, *Albemarle Street*, W.
Bankers—The London and Westminster Bank, *St. James's Square Branch*, S.W.

STANDING COMMITTEES FOR 1882.

Finance Committee.

Kingscote, Colonel (Chairman).
Bridport, General Viscount.
Ridley, Sir M. White, Bt.
Frankish, W.
Randell, Charles.
Shuttleworth, J.

House Committee.

The President.
Chairman of Finance Committee.
Bridport, General Viscount.
Gibbs, Sir Brandreth.
Randell, C.
Shuttleworth, J.
Wilson, Jacob.

Journal Committee.

Cathcart, Earl (Chairman).
Ridley, Sir M. White, Bt.
Chandos-Pole-Gell, H.
Dent, J. D.
Frankish, W.
Hemsley, J.
Howard, J.
Jones, J. Bowen.
Little, H. J.
Loyd-Lindsay, Col. Sir R.
Ransome, R. C.
Thorold, Sir John H., Bt.
Turbervill, Lieut.-Col.
Wells, W.
Whitehead, Charles.

Chemical Committee.

Wells, William (Chairman).
Bedford, Duke of.
Moreton, Lord.
Vernon, Lord.
Macdonald, Sir A. K., Bt.
Arkwright, J. H.
Dent, J. D.
Howard, C.
Jones, J. Bowen.
Lawes, J. B.
Neville, R.
Turbervill, Lieut.-Col.
Voelcker, Dr. A.
Wakefield, W. H.
Warren, R. A.
Whitehead, Charles.

Seeds and Plant-Diseases Committee.

Whitehead, Charles (Chairman).
Vernon, Lord.
Gibbs, Sir Brandreth.
Arkwright, J. H.
Carruthers, W.
Frankish, W.
Gorringe, H.
Jones, J. Bowen.
Little, H. J.
Parker, Hon. C. T.
Turbervill, Lieut.-Col.
Voelcker, Dr.

Veterinary Committee.

Egerton, Hon. Wilbraham (Chairman).
Bridport, General Viscount.
Moreton, Lord.
Ridley, Sir M. White, Bt.
Gibbs, Sir Brandreth.
Allender, G. M.
Ashworth, A.
Brown, Professor.
Chandos-Pole-Gell, H.
Fleming, George.
Foster, S. P.
Harpley, M. J.
Kingscote, Colonel.
Parker, Hon. C. T.
Robertson, Professor.
Sanday, G. H.
Sanderson, Dr. J. Burdon.
Simonds, Professor.
Stratton, R.
Wakefield, W. H.
Wilson, Jacob.

Stock-Prizes Committee.

Chandos-Pole-Gell, H. (Chairman).
Bridport, Gen. Viscount.
Moreton, Lord.
Gibbs, Sir Brandreth.
Arkwright, J. H.
Ashworth, A.
Aylmer, H.
Evans, John.
Frankish, W.
Gilbey, Walter.
Gorringe, H.
Hemsley, J.
Howard, C.
Martin, J.
Pain, T.
Randell, C.
Sanday, G. H.
Sheraton, W.
Simonds, Prof.
Stratton, R.
Turner, George.
Wakefield, W. H.
Wilson, Jacob.
Wise, G.
The Stewards of Live Stock.

Implement Committee.

HEMSLEY, J. (Chairman).
BRIDPORT, Gen. Viscount.
VERNON, Lord.
MORETON, Lord.
GIBBS, Sir BRANDRETH.
ALLENDER, G. M.
ANDERSON, W.
ASHWORTH, A.
FRANKISH, W.
GORRINGE, H.
HOWARD, C.
HOWARD, J.
JONES, J. BOWEN.
MARTIN, J.
NEVILLE, R.
PARKER, Hon. C. T.
RANSOME, R. C.
SANDAY, G. H.
SHERATON, W.
SHUTTLEWORTH, JOSEPH.
STRATTON, R.
TURBERVILL, Lieut.-Col.
TURNER, JABEZ.
WILSON, JACOB.
The Stewards of Implements.

General York Committee.

DENT, J. D. (Chairman).
BRIDPORT, Gen. Viscount
FEVERSHAM, Earl of.
MORETON, Lord.
RAVENSWORTH, Earl of.
VERNON, Lord.
RIDLEY, Sir M. W., Bt.
GIBBS, Sir BRANDRETH.
ASHWORTH, A.
AYLMER, H.
BOOTH, J. B.
CHANDOS-POLE-GELL, H.
FOSTER, S. P.
FRANKISH, W.
GORRINGE, H.
HEMSLEY, J.
HOWARD, C.
JONES, J. BOWEN.
KINGSCOTE, Colonel.
NEVILLE, R.
PARRINGTON, T.
RANDELL, CHARLES.
SANDAY, G. H.
SHERATON, W.
SHUTTLEWORTH, J.
STEPHENSON, MARSHALL.
TURBERVILL, Lieut.-Col.
WAKEFIELD, W. H.
WELLS, W.
WHITEHEAD, CHARLES.
WILSON, JACOB.
The LORD MAYOR of YORK.
The TOWN CLERK of YORK.

Show-Yard Contracts Committee.

SHUTTLEWORTH, JOSEPH (Chairman).
GIBBS, Sir BRANDRETH.
CHANDOS-POLE-GELL, H.
FRANKISH, W.
HEMSLEY, J.
HOWARD, C.
RANDELL, CHARLES.
SANDAY, G. H.
STRATTON, R.
WILSON, JACOB.

Committee of Selection.

CATHCART, Earl (Chairman).
RIDLEY, Sir M. W.
FRANKISH, W.
RANDELL, C.
TURBERVILL, Lieut.-Col.
WAKEFIELD, W. H.
WILSON, JACOB.

And the Chairmen of the Standing Committees.

Education Committee.

MORETON, Lord (Chairman).
BEDFORD, Duke of.
DENT, J. D.
CARRUTHERS, W.
JONES, J. BOWEN.
KINGSCOTE, Colonel.
LITTLE, H. J.
PARKER, Hon. CECIL T.
TURBERVILL, Lieut.-Col.
VOELCKER, Dr.

Dairy Committee.

VERNON, Lord (Chairman).
BRIDPORT, Gen. Viscount.
CHESHAM, Lord.
MACDONALD, Sir A. K.
ALLENDER, G. M.
CHANDOS-POLE-GELL, H.
JONES, J. BOWEN.
KINGSCOTE, Colonel.
NEVILLE, R.
STRATTON, R.
THOROLD, Sir JOHN H., Bt
VOELCKER, Dr.

Cattle Plague Committee.

THE WHOLE COUNCIL.

*** The PRESIDENT, TRUSTEES, and VICE-PRESIDENTS are Members *ex officio* of all Committees.

Royal Agricultural Society of England.

GENERAL MEETING,

12, Hanover Square, Monday, May 22nd, 1882.

REPORT OF THE COUNCIL.

The Council have to announce that the list of the Society during the past year has been diminished by the resignation of 149 Members, as well as by the death of 7 Governors and 181 Members, and the removal of 58 Members by order of the Council. Since the last General Meeting in December these deficiencies have been repaired by the election of 2 Governors and 185 Members.

The Society now consists of

82 Life Governors,
71 Annual Governors,
2849 Life Members,
5059 Annual Members,
19 Honorary Members—

making a total of 8080, and showing a decrease of 42 since the December General Meeting, but an increase of 101 since the last Annual Meeting in May, 1881.

Since the last General Meeting the Council have sustained a severe loss by the death of their much-esteemed colleague, Mr. Aveling, of Rochester, and the vacancy caused thereby is still under the consideration of the Council.

The vacancies in the Council caused by the death of Mr. Carrington and Mr. Bowly have been filled up by the election

of the Marquis of Stafford, M.P., and Mr. R. A. Warren, of Preston Place, Arundel.

The accounts for the year 1881 have been examined and certified by the auditors and accountants of the Society, and have been published in the last number of the 'Journal,' together with the statement of receipts and expenditure of the Derby Meeting. The funded property of the Society has been increased by the investment of 3000*l.*, and now stands at 18,423*l.* 1*s.* 9*d.* New Three per Cents. The balance of the current account in the hands of the Society's bankers on the 1st instant was 4951*l.* 0*s.* 8*d.*, and 2000*l.* remained on deposit.

The Reading Meeting will commence on Monday, July 10th, and will close on Friday, July 14th; but the Implement Yard will be open to the public on Saturday, the 8th.

The Reading Local Committee have added to the Society's Prize-list offers of Prizes for Agricultural Horses, Hackneys and Hunters, Dairy Cattle, Cheese and Butter; while two Members of the Council have added to the list of Prizes for Horses, and the Hereford Herd-Book Society have offered Prizes in a class for families of that breed.

The continued interest which has attached to the exhibition of Dairy machinery at work, coupled with the expressed desire of manufacturers of Dairy implements to have the opportunity of showing their own methods of production in so favourable a manner, has led the Council to try the experiment of throwing open the Working Dairy, in sections, to those exhibitors who choose to take space for the purpose and to comply with the Society's regulations.

The district assigned for the Country Meeting of 1883 is restricted to the County of York, and the Council have accepted a very cordial invitation which they received from the Lord Mayor and the Town Council of the City of York to hold the Show next year on a portion of the well-known race-course. The Council are very glad to announce in addition that the

Yorkshire Agricultural Society have agreed to merge their Annual Meeting with that of the Royal, on terms which will no doubt be found mutually advantageous.

The Country Meeting for the year 1884 will be held in the district which includes South Wales and the counties of Gloucester, Hereford, Monmouth, Salop, Stafford, Warwick and Worcester.

The Council have much pleasure in reporting that at the invitation of the Manchester and Liverpool Agricultural Society, they took the initiative in organizing a deputation to the General Managers of the chief Railway Companies with a view to obtain some reduction in the charges for the conveyance of Live Stock to and from the Shows of Agricultural Societies. The requests of this deputation were very moderate, and were granted by the General Managers as being fair both to the Railway Companies and the Agricultural Societies. They embrace the following important concessions:—

1. Stock to be conveyed full fare to the Show, but half fare on the return journey if unsold.
2. Men *bonâ fide* in charge of stock to be conveyed free.
3. The foregoing regulations to apply to animals whether carried in horse-boxes and by passenger or special trains, or in cattle trucks and by luggage trains.

The Veterinary Privileges of the Members are under the consideration of the Council, with a view to the appointment of Veterinary Surgeons to the Society at certain centres in England and Wales.

The investigation into the life-history of the Liver-fluke is being continued by Mr. Thomas, whose researches seem to promise results of the greatest importance in relation to the causes and prevention of Sheep-rot, and the Council have therefore made an additional grant towards the completion of his inquiry.

The Medals and Prizes offered by the Society to Graduates

of the Royal College of Veterinary Surgeons for proficiency in "Cattle Pathology," have been awarded as follows:—

Gold Medal and 20*l.*, Mr. J. S. Wheatcroft, Sandiacre, near Nottingham.

Silver Medal and 10*l.*, Mr. W. F. Barrett, 100, St. Donatt's Road, New Cross, S.E.

Bronze Medal and 5*l.*, Mr. G. G. Mayor, Kirkham, Lancashire.

The Council have authorized a new series of experiments with regard to the propagation, the prevention, and the treatment of Foot-and-mouth disease, but up to the present time no results of importance have been arrived at, in consequence of the difficulty of obtaining notice of cases in the earliest stages of the disease.

The Council are glad to report that the services of the Consulting Botanist are becoming more sought for by Members of the Society, especially with regard to the germinating power of grass-seeds, the importance of which has hitherto been greatly neglected. The following standard is adopted by Mr. Carruthers in his examination of seeds, and they recommend that purchasers should require a guarantee in accordance with it:—

1. That the bulk be true to the species ordered.
2. That it contain not more than 5 per cent. of seeds other than the species ordered.
3. That the germinating power shall be, for cereals, green crops, clovers, and timothy grass, not less than 90 per cent.; for fox-tail, not less than 20 per cent.; and for other grasses not less than 70 per cent.

The Council, having in view the serious and increasing attacks of insects on farm-crops, have appointed Miss Ormerod Hon. Consulting Entomologist to the Society, and have arranged that the fee for consultation should be 2*s.* 6*d.* for each case, and they have much pleasure in announcing that Miss Ormerod has accepted the appointment.

Thirteen candidates entered their names for examination for the Society's Senior Prizes and Certificates, and of these nine presented themselves on the 9th inst. and four succeeding days; but the only candidate who satisfied the Examiners in all the compulsory subjects was Mr. G. J. M. Burnett, B.A., of the Royal Agricultural College, Cirencester, and St. John's College, Cambridge, who obtains the First Class Certificate, the Life Membership of the Society, and the First Prize of 25*l.* The Examiners for the Junior Scholarships competed for last November have certified that the following candidates have succeeded, in addition to those previously reported:—

William Byrne and Alexander McConnell, both of the Albert Institution, Glasnevin, near Dublin.

By Order of the Council,

H. M. JENKINS,

Secretary.

ROYAL AGRICULTURAL

Dr. **HALF-YEARLY CASH ACCOUNT**

	£ s. d.	£ s. d.	£ s. d.
To Balance in hand, 1st January, 1882:—			
Bankers		562 9 0	
Secretary		25 9 2	
			587 18 2
To Income:—			
Dividends on Stock		270 11 10	
Subscriptions:—			
Governors' Life Composition	90 0 0		
Governors' Annual	270 0 0		
Members' Life-Compositions	855 0 0		
Members' Annual	3,914 2 0		
		5,129 2 0	
Establishment:—			
Rent		100 0 0	
Journal:—			
Sales	74 15 9		
Advertisements	130 12 5		
		205 8 2	
Chemical:—			
Laboratory Fees		174 3 0	
Veterinary:—			
Professional Fees		2 12 6	
Sundries:—			
On Account of London Exhibition	45 4 0		
Miscellaneous	2 0 0		
		47 4 0	
Derby Meeting		233 14 1	
Total Income		.. .. ..	6,162 15 7
To Reading Meeting		.. .. ..	7,336 9 1
			£14,087 2 10

BALANCE-SHEET,

LIABILITIES.	£ s. d.	£ s. d.	£ s. d.
To Capital:—			
Surplus, 31st December, 1881		23,297 8 0	
Surplus of Income over Expenditure during the Half-year, viz.:—			
Income	6,162 15 7		
Expenditure	3,672 7 0		
		2,490 8 7	
			25,787 16 7
Deduct half-year's interest and depreciation on Country Meeting Plant		.. .. ..	221 5 8
			£25,566 10 11

QUILTER, BALL, CROSBIE, GLEGG & WELTON, *Accountants.*

SOCIETY OF ENGLAND.

FROM 1ST JANUARY TO 30TH JUNE, 1882. CR.

	£ s. d.	£ s. d.	£ s. d.
By Expenditure:—			
Establishment:—			
Salaries, Wages, &c.	796 13 4		
House:—Rent, Taxes, &c.	551 5 9		
Office:—Printing, Postage, Stationery, &c.	257 8 5		
		1,605 7 6	
Journal:—			
Printing and Stitching	562 12 0		
Printing Advertisements	47 18 6		
Postage and Delivery	200 0 0		
Advertising	25 9 7		
Literary Contributions	99 0 0		
Engravings	21 6 0		
Pamphlets	10 15 0		
		967 1 1	
Chemical:—			
Salaries	438 10 0		
Chemicals	21 6 5		
Petty Payments	5 0 0		
		464 16 5	
Veterinary:—			
Prizes and Medals	47 12 0		
Fees to Examiners	22 2 3		
Professional Fees	12 14 0		
On Account of Investigation	200 0 0		
		282 8 3	
Botanical:—			
Consulting Botanist's Salary	50 0 0		
Seeds, &c.	5 12 4		
		55 12 4	
Education:—			
Fees to Examiners	36 15 0		
Printing and Advertising	56 6 0		
Prizes	25 0 0		
		118 1 0	
Farm Inspection:—			
Advertising		49 8 3	
Sundries:—			
On Account of London Exhibition	25 14 6		
Miscellaneous	7 1 8		
		32 16 2	
Subscriptions (paid in error) returned		4 0 0	
Derby Meeting		92 16 0	
Total Expenditure			3,672 7 0
By Reading Meeting			6,212 0 9
By Balance in hand, 30th June:—			
Bankers	2,171 5 5		
Secretary	31 9 8		
		2,202 15 1	
At Deposit		2,000 0 0	
			4,202 15 1
			£14,087 2 10

30TH JUNE, 1882.

ASSETS.	£ s. d.	£ s. d.
By Cash in hand	2,202 15 1	
By New 3 per Cent. Stock 18,423*l.* 1*s.* 9*d.* cost*	17,677 17 1	
By Books and Furniture in Society's House	1,451 17 6	
By Country Meeting Plant	2,729 3 6	
By Deposit Account	2,000 0 0	
		26,061 13 2
List at credit of Reading Meeting		495 2 3
		£25,566 10 11

* *Value at* 99¼ = £18,330 19*s.* 5*d.*

Mem.—The above Assets are exclusive of the amount recoverable in respect of arrears of Subscription to 30th June, 1882, which at that date amounted to 2370*l.*

Examined, audited, and found correct, this 14th day of August, 1882.

FRANCIS SHERBORN,
A. H. JOHNSON,
C. GAY ROBERTS,
} *Auditors on behalf of the Society.*

READING MEETING,

1882.

STEWARDS OF DEPARTMENTS.

Implements.

Lord Vernon.
J. Bowen Jones.
Lord Moreton, M.P.

Stock.

Charles Howard.
S. P. Foster.
Jabez Turner.
Hugh Gorringe.

Engineering.

Robert Neville.

Forage.

Alfred D. Wells.

Finance.

Charles Randell.
William Frankish.

General Arrangements.

Jacob Wilson.

JUDGES OF STOCK.

HORSES.

Agricultural.

Thomas Plowright.
Samuel Rowlandson.

Clydesdale.

Robert Findlay.
Thomas Kerr.

Suffolk.

E. Hodgson.
Daniel Sewell.

Hunter.

Major C. Rivers Bulkeley.
T. H. Hutchinson.

Hackney.

William Parker.
John Rowell.

CATTLE.

Shorthorn.

Hugh Aylmer.
Francis Tallant.

Hereford.

H. Haywood.
G. W. Baker.

Devon, Sussex, Norfolk, and Suffolk Polled.

Herman Biddell.
S. P. Newberry.
John Noake.

Longhorn and Dairy Cattle.

J. H. Burbery.
John Denchfield.

Jersey and Guernsey.

Edmund B. Gibson.
Col. C. P. Le Cornu.

SHEEP.

Leicester and Lincoln.

H. MacKinder.
Wm. Sanday.

Cotswold, Kentish, Romney Marsh, Devon, and other Long-woolled Breeds.

Robert Garne.
Ambrose Warde.

Oxfordshire Down.

James P. Case.
Henry Overman.

Shropshire.

Peter Everall.
C. R. Keeling.

Southdown.

Thomas Fulcher.
John A. Hempson.

Hampshire and other Short-woolled Breeds.

F. Budd.
John G. King.

PIGS.

G. M. Sexton
Sanders Spencer.

INSPECTORS OF SHEARING.

James E. Rawlence. | J. B. Workman.

JUDGES OF BEE-KEEPING APPLIANCES.

Rev. E. Bartrum. | Thos. W. Cowan. | W. H. Harris.
J. M. Hooker. | Rev. S. R. Wilkinson.

JUDGES OF BUTTER AND CHEESE.

James Eastty. | James Hudson.

JUDGES OF FRUIT AND VEGETABLES.

William Chambers. | Henry Swann.

JUDGES OF IMPLEMENTS.

Mason Cooke. | George H. Sanday. | T. F. Jackson.
William C. Little. | George Gibbons. | J. W. Kimber.

JUDGES OF FARMS.

J. H. Blundell. | James Long. | William Parsons.

AWARDS OF PRIZES.

NOTE.—The Judges were instructed, in addition to awarding the Prizes, to designate as the *Reserve Number* one animal in each Class, next in order of merit, if it possessed sufficient for a Prize; in case an animal to which a Prize was awarded should subsequently become disqualified.

Prizes given by the Reading Local Committee are marked thus (*).

HORSES.

Agricultural Stallions foaled in either 1875, 1876, 1877, *or* 1878.

THOMAS SHAW, the Island, Winmarleigh, Garstang, Lancashire: FIRST PRIZE, 25*l*., and the CHAMPION PRIZE of 25*l*.,† for "Cromwell," brown; was foaled in 1877; bred by Mr. C. Loweth, Holbeach Hurn, Lancashire; sire, "Thumper" (2136).

WALTER GILBEY, Elsenham Hall, Bishops Stortford: SECOND PRIZE, 15*l*., for "Spark," black; was foaled in 1878; bred by Mr. Rowland, Creslow, Aylesbury; sire, "The Colonel" (2101); dam, "Daisy," by "King Charles" (1207).

JOHN LEWIN CURTIS, Chatteris, Cambridgeshire: THIRD PRIZE, 5*l*., for "Crown Prince" (561), bay; was foaled in 1876; bred by Mr. John Fryer, The Priory, Chatteris; sire, "Grand Prince;" dam, "Gipsey," by Engledon's "Farmer's Friend."

Colonel Sir R. Loyd Lindsay, V.C., K.C.B., M.P., Lockinge Park, Wantage, Berks: the *Reserve Number* and *Highly Commended* for "Netley," chestnut; was foaled in 1877; bred by himself; sire, "Prince Albert" (613); dam, "Florence Nightingale."

Agricultural Stallions foaled in the Year 1879.

THE EARL OF ELLESMERE, Worsley Hall, Manchester: FIRST PRIZE, 20*l*., for "Silent James" (2668), bay; bred by Mr. R. Porter, Fleetwood, Lancashire; sire, "What's Wanted" (2332); dam by "Honest Tom" (1105).

The Hon. E. K. W. COKE, Longford Hall, Derby: SECOND PRIZE, 10*l*., for "Conjuror" (2559), brown; bred by Mr. T. Flowers, Beachendon, Aylesbury: sire, "Drayman" (670); dam, "Bonny."

† Given by a Member of the Council of the Society for the best Agricultural Stallion in the first three classes.

SAMUEL SHAW, Brooklands, Halifax, Yorks: THIRD PRIZE, 5*l.*, for "Northern King," bay; bred by Mr. Wilding, Woodacre Hall, Garstang: sire, "What's Wanted;" dam, "Gipsy," by "Honest Tom."

GARRETT TAYLOR, Trowse House, Norwich: the *Reserve Number* and *Highly Commended*, for "Invincible Wonder" (2596), chestnut; bred by Mr. J. Green, Welshpool; sire, "England's Wonder" (761); dam by "Noble Gold Finder" (1643).

Agricultural Stallions foaled in the Year 1880.

The Hon. E. K. W. COKE, Longford Hall, Derby: FIRST PRIZE, 15*l.*, for "Certainty," chestnut; bred by Mr. Tinsley, Holbeach, Lincolnshire; sire, "Lincolnshire Tom" (1367); dam by "Admiral" (69).

THE EARL OF ELLESMERE, Worsley Hall, Manchester: SECOND PRIZE, 10*l.*, for "Eclipse" (2571), bay; bred by Mr. H. Potter, Lockington Grounds, Derby; sire, "What's Wanted" (2332); dam by "Samson" (1947): and THIRD PRIZE, 5*l.*, for "Oak Branch" (2638), bay; bred by Mr. T. S. Minton, Montford, Shrewsbury; sire, "Heart of Oak;" dam, "Blackbird."

WALTER GILBEY, Elsenham Hall, Bishops Stortford: the *Reserve Number* and *Highly Commended* for "Shire King," roan; bred by Mr. R. K. Porter, Haddenham, Isle of Ely; sire, "Ploughboy" (1752); dam, "Damby."

Clydesdale Stallions foaled in either 1875, 1876, 1877, *or* 1878.

JAMES WHYTE, Aldbro' Hall, Darlington: FIRST PRIZE, 20*l.*, for "Pointsman" (1236), bay; was foaled in 1877; bred by himself; sire, "Tam O'Shanter" (851); dam, "Rose," by "Lord Derby" (485).

JOHN THOMSON, Wilson Hall, Melbourne, Derby: SECOND PRIZE, 15*l.*, for "Glen Garry," bay; was foaled in 1877; bred by himself; sire, "Young Lofty;" dam, "Princess," by "Prince of Wales."

The DUKE OF RICHMOND AND GORDON, K.G., Goodwood, Chichester: THIRD PRIZE, 5*l.*, for "Prince Charlie," bay; was foaled in 1875; bred by Mr. L. Drew, Merryton, Hamilton, N.B.; sire, "Prince of Wales;" dam, "Bella."

Clydesdale Stallions foaled in the Year 1879.

JOHN DASHWOOD LANG, Knowle, Sidmouth, Devonshire: FIRST PRIZE, 20*l.*, for "Victor Chief" (1855), black; bred by Lord Dunmore, Dunmore, N.B.; sire, "Prince Charlie" (634); dam, "Dunmore Maggie" (87), by "Victor" (692).

EDWARD ORMOND, Wantage, Berks: SECOND PRIZE, 10*l.*, for "Dictator," brown; bred by Lord Dunmore; sire, "Prince Charlie" (634); dam, "Darling."

Clydesdale Stallions foaled in the Year 1880.

GEORGE RODGER, Newton Bank, Preston Brook, Chester: FIRST PRIZE, 15*l.*, and the CHAMPION PRIZE of 25*l.*,† for "Warlock," chestnut; bred by himself; sire, "Druid" (1120); dam, "Mystery" (881), by "Craigie Lea" (204).

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† Given by a Member of the Council of the Society for the best Clydesdale Stallion.

The MARQUESS OF LONDONDERRY, Seaham Hall, Seaham Harbour, Durham: SECOND PRIZE, 10*l.*, for "Viscount," bay; bred by himself; sire, "What Care I" (912); dam, "Countess" by "Lochfergus Champion" (449).

Suffolk Stallions foaled in either 1875, 1876, 1877, *or* 1878.

SAMUEL WOLTON, Butley Abbey, Wickham Market, Suffolk: FIRST PRIZE, 25*l.*, for "Chieftain" (1354), chestnut; was foaled in 1877; bred by himself; sire, "Cupbearer 2nd" (542); dam, "Princess" (1095), by "Warrior" (1353).

JOHN GROUT, Woodbridge, Suffolk: SECOND PRIZE, 15*l.*, for "Middleton," chestnut; was foaled in 1878; bred by Mr. Spalding, Middleton, Yoxford, Suffolk; sire, "Tiptop."

Suffolk Stallions foaled in the Year 1879.

SAMUEL WOLTON, Butley Abbey, Wickham Market: FIRST PRIZE, 20*l.*, for "Chief of the East," chestnut; bred by himself; sire, "Tiptop" (1367); dam, "Princess" (1095), by "Warrior" (1353).

WILLIAM WILSON, Baylham Hall, Ipswich, Suffolk: SECOND PRIZE, 10*l.*, for "Light Heart," chestnut: bred by Mr. J. Lawton, Darmsden, Needham Market; sire, "Champion" (680); dam, "Depper," by "Old Briton" (1308).

THE DUKE OF HAMILTON AND BRANDON, K.T., Easton Park, Wickham Market: THIRD PRIZE, 5*l.*, for "Easton Emperor," chestnut; bred by Mr. Mumford, Creeting St. Peter, Suffolk; sire, "Wilson's Bismarck;" dam by "Harwich Emperor."

JOHN GROUT, Woodbridge, Suffolk: the *Reserve Number* and *Highly Commended* for "Stavenger," chestnut; bred by Mr. Lewin, Wantisden Hall, Wickham Market; sire, "Monarch 2nd;" dam by "Briton."

Suffolk Stallions foaled in the Year 1880.

THE DUKE OF HAMILTON AND BRANDON, K.T., Easton Park, Wickham Market: FIRST PRIZE, 15*l.*, for "The Chief," chestnut; bred by himself; sire, "Statesman;" dam, "Emerald," by "Grout's Emperor."

HORACE WOLTON, Newbourne Hall, Woodbridge: SECOND PRIZE, 10*l.*, for "Multum in Parvo," chestnut; bred by himself; sire, "Royalty" (1339); dam, "Empress of Paris" (1033), by "Royal Duke 2nd" (1366).

ROBERT HENRY WRINCH, Harkstead, Ipswich, Suffolk: THIRD PRIZE, 5*l.*, for "The Wanderer," chestnut; bred by Mr. G. Pettit, Friston, Aldborough; sire, "Cupbearer 3rd" (566); dam, "Diamond," by "Plough Boy" (1204).

SAMUEL WOLTON, Butley Abbey, Wickham Market: the *Reserve Number* and *Highly Commended* for "Waxwork," chestnut; bred by himself; sire, "Chieftain" (1354); dam, "Foxhall Victory" (1080), by "Magnum Bonum" (1347).

Thoroughbred Stallions suitable for getting Hunters.

HENRY WARING, Beenham House, Reading: FIRST PRIZE, 50*l.*,† for "King of the Forest," bay; was foaled in 1868; bred by the late Mr. J. Merry; sire, "Scottish Chief;" dam, "Lioness," by "Fandango."

† Half of this Prize was given by a Member of the Council of the Society.

Colonel Barlow, Hasketon, Woodbridge, Suffolk: Second Prize, 15*l*., for "Philammon," bay; was foaled in 1878; bred by Lord Drogheda, Moore Abbey, Monasteraven, Ireland; sire, "Solon;" dam, "Satanella," by "Wild Dayrell."

Stallions suitable for getting Hackneys.

John Grout, Woodbridge, Suffolk: First Prize, 20*l*., for "Fashion," brown; was foaled in 1878; bred by Mr. R. Worsley, Suffield Hall, Norfolk; sire, "Confidence."

James Griggs, South Creake, Fakenham, Norfolk: Second Prize, 10*l*., for "Model the 2nd," chestnut; was foaled in 1875; bred by himself; sire, "Washington;" dam, "Merrylegs," by Baldwin's "Robin Hood."

John Conchar, Wylde Green, Birmingham, Warwickshire: Third Prize, 5*l*., for "Lord of the Isles," chestnut; was foaled in 1878; bred by Mr. J. L. Heaton, Commercial Street, Batley, Yorkshire; sire, "Charley Merrylegs;" dam by "Bounding Willow."

William Catton Branford, 86, George Street, Edinburgh: the *Reserve Number* to "Vermaak," brown; was foaled in 1875; bred by himself; sire, "Leybourne;" dam, "Acherner," by "Idler."

Pony Stallions foaled in the Year 1875 *or since.*

James Firth Crowther, Knowl Grove, Mirfield, Yorkshire: First Prize, 15*l*., for "Nobby," chestnut; was foaled in 1878; bred by Mr. R. Cowten, Potter Brompton, Ganton, Yorks; sire, "Calcutta;" dam by "Triffitt's Fireaway."

John Grout, Woodbridge, Suffolk: Second Prize, 10*l*., for "Young Honesty," brown; was foaled in 1877; bred by Mr. Coker, Beetley Hall, Dereham, Norfolk; sire, "Honesty."

Charles Yealand, Calverton, Nottinghamshire: the *Reserve Number* to "Pride of the Forest," brown; was foaled in 1879; bred by himself; sire, "Whalebone;" dam, "Sweet Alice," by "Pride of the Isle."

Agricultural Mares and Foals.

T. H. Miller, Singleton Park, Poulton-le-Fylde, Lancashire: First Prize, 20*l*., for "Princess Dagmar," bay; was foaled in 1876 (foal by "Lincoln" (1350)); bred by himself; sire, "Honest Tom" (1105); dam, "Princess of Wales," by "King Alfred" (2442).

The Duke of Westminster, K.G., Eaton Hall, Chester: Second Prize, 10*l*., for "Lady Whitelock," roan; was foaled in 1877 (foal by "Sam" (2665)); bred by Mr. J. Fairclough, Outrawcliffe, Garstang, Lancashire; sire, "What's Wanted" (2332); dam by "Master of Arts" (1500).

T. H. Miller, Singleton Park, Poulton-le-Fylde, Lancashire: Third Prize, 5*l*., for "Bessie," bay; was foaled in 1878 (foal by "Lincoln" (1350)); bred by Mr. W. Shaw, jun., The Raikes, Thornton, Poulton-le-Fylde; sire, "Honest Tom" (1105); dam, "Flower," by "England's Glory" (732).

Walter Gilbey, Elsenham Hall, Bishops Stortford: the *Reserve Number* to "Magdalen Beauty," bay; was foaled in 1873 (foal by "Spark" (2497)); bred by Mr. W. Chambers, Magdalen, Norfolk; sire, "Brown George" (319).

Clydesdale Mares and Foals.

THE DUKE OF RICHMOND AND GORDON, K.G., Goodwood, Chichester, Sussex: FIRST PRIZE, 20*l.*, for "Lily," bay; was foaled in 1877 (foal by "Prince Charlie); bred by himself; sire, "Johnny" (414); dam, "Rose" (360), by "Largs Jock" (444).

EDWARD and ALFRED STANFORD, Eatons, Ashurst, Steyning, Sussex: SECOND PRIZE, 10*l.*, for "Lady Strathmore," bay; was foaled in 1878 (foal by "The Duke" (860); bred by Col. Williamson, Lawers, Crieff, N.B.; sire, "Thane of Glamis" (855); dam, "Nell," by "Sir Colin" (776).

JOHN DASHWOOD LANG, Knowle, Sidmouth, Devon: THIRD PRIZE, 5*l.*, for "Kilbowie Maid," bay; was foaled in 1877 (foal by "Topsman" (886)); bred by Mr. John Thorn, Boymaieston, Coylton, Ayrshire; sire, "Ivanhoe" (396); dam, "Flora," by "Largs Jock" (444).

THE MARQUESS OF LONDONDERRY, Seaham Hall, Seaham Harbour, Durham: the *Reserve Number* and *Highly Commended* for "Milkmaid," bay; was foaled in 1877 (foal by "What Care I)" (912); bred by Mr. Crawford, Chapel, Kilmalcolm, N.B.; sire, "Prince Charlie" (629); dam by "Lord Clyde" (475).

Suffolk Mares and Foals.

THE DUKE OF HAMILTON AND BRANDON, K.T., Easton Park, Wickham Market, Suffolk: FIRST PRIZE, 20*l.*, for "Culpho Belle," chestnut; was foaled in 1878 (foal by "Rodney"); bred by Mr. Thompson, Culpho Hall, Ipswich; sire, "Major Snap;" dam, "Scott," by "Captain Snap."

Hunter Mares and Foals.

ERNEST G. C. BOMFORD, Spring Hill, Pershore, Worcestershire: FIRST PRIZE, 20*l.*, for his chestnut; was foaled in 1871 (foal by "Prosper"); bred by the Rev. W. Parker, Comberton, Pershore; sire, "Wantage."

RALPH JACKSON, Brentford Grange, Amersham, Bucks: SECOND PRIZE, 10*l.*, for "Mary," grey, aged (foal by "Mr. Winkle"); breeder unknown; sire, "Picador;" dam by "Robin Grey."

WILLIAM PARKER, Great Stanney Hall, Chester: THIRD PRIZE, 5*l.*, for "Fanny," brown; age and breeder unknown (foal by "Thorwalsden); sire, "Old Calabar."

Hackney Mares and Foals.

T. H. MILLER, Singleton Park, Poulton-le-Fylde, Lancashire: FIRST PRIZE, 15*l.*, for "Belle," bay, aged (foal by "Young President"); breeder unknown.

THE DUKE OF HAMILTON AND BRANDON, K.T., Easton Park, Wickham Market: SECOND PRIZE, 10*l.*, for "The Spotted Mare," spotted roan; age and breeder unknown (foal by "Young Performer").

BENJAMIN HOWDLE, North Cave, Brough, Yorks: THIRD PRIZE, 5*l.*, for "Bonnie Belle," chestnut; was foaled in 1877 (foal by "President);" bred by Mr. F. Stather, North Cave, Brough; sire, "Telegraph;" dam, "Fanny."

Pony Mares and Foals.

THE DUKE OF HAMILTON AND BRANDON, K.T., Easton Park, Wickham Market: FIRST PRIZE, 15*l.*, for "The French Mare," bay, aged (foal by "Prickwillow"); breeder unknown.

Agricultural Fillies foaled in the Year 1879.

WALTER GILBEY, of Elsenham Hall, Bishops Stortford: FIRST PRIZE, 15*l.*, for "Chocolate," brown; bred by Mr. Appleby, Snalston, Ashbourne, Derbyshire; sire, "Birkland (133); dam by "Waxwork (2306).

H.R.H. THE PRINCE OF WALES, K.G., Sandringham, Norfolk: SECOND PRIZE, 10*l.*, for "Jewel," black; bred by Mr. W. Lawrensen, Preesall, Garstang, Lancashire; sire, "Sir Colin;" dam by "Ploughboy."

T. H. MILLER, of Singleton Park, Poulton-le-Fylde: THIRD PRIZE, 5*l.*, for "Mascotte," bay; bred by Mr. W. Jackson, Singleton, Kirkham, Lancashire; sire, "Lincoln (1350); dam, "Maggie," by "Master of Arts" (1500).

PHILIP ALBERT MUNTZ, Dunsmore, Rugby, Warwickshire: the *Reserve Number* and *Highly Commended* for "Fancy," bay; bred by Mr. Messenger, Northamptonshire; sire, "Tichborne;" dam by "Drayman."

Agricultural Fillies foaled in the Year 1880.

THE HON. E. K. W. COKE, Longford Hall, Longford, Derby: FIRST PRIZE, 15*l.*, for "Chance," black; bred by Mr. W. Lawrensen, Ash Farm, Preesall, Lancashire; sire, "Lincoln" (1350); dam, "Brock," by "Ploughboy" (1745).

T. H. MILLER, Singleton Park, Poulton-le-Fylde: SECOND PRIZE, 10*l.*, for "Magpie," black; bred by Mr. R. Silcock, Thornton Hall, Poulton-le-Fylde; sire, "Lincoln" (1350); dam, "Pink," by "Sir Colin" (2022).

JOHN MORTON, Fences Farm, Stow, Downham Market, Norfolk: THIRD PRIZE, 5*l.*, for "Lioness II," chestnut; bred by himself; sire, "Wonder of the West" (2371); dam, "Flower," by "Samson" (1981).

THE HON. E. K. W. COKE, Longford Hall: the *Reserve Number* to "Carouse," chestnut; bred by himself; sire, "Merry Boy (1547); dam, "Charcoal," by "King of the Vale."

Clydesdale Fillies foaled in the Year 1879.

ARTHUR PEASE, M.P., Hummersknott, Darlington, Durham: FIRST PRIZE, 15*l.*, for "Trimmer," dark brown; bred by himself; sire, "Tam O'Shanter; dam, "Smiler," by "The Laird."

THE MARQUESS OF LONDONDERRY, Seaham Hall, Durham: SECOND PRIZE, 10*l.*, for "Mona," brown; bred by himself; "What Care I" (912); dam, "Nance" (573), by "Farmer" (286).

THE DUKE OF RICHMOND AND GORDON, K.G., Goodwood, Chichester: the *Reserve Number* and *Commended* for "Lady Florence," bay; bred by himself; sire, "Prince Albert Victor (617); dam, "Duchess of Beaufort" (362), by "Sir Robert" (787).

Clydesdale Fillies foaled in the Year 1880.

ROBERT LODER, M.P., Whittlebury, Towcester, Northamptonshire: FIRST PRIZE, 15*l.*, for "Flora," bay; bred by Lord Dunmore, Falkirk, N.B.; sire, "Darnley" (222); dam, "Flora McDonald," by "Time o'Day" (875).

THE MARQUESS OF LONDONDERRY, Seaham Hall, Durham: SECOND PRIZE, 10*l.*, for his bay; bred by Mr. Lawrence Drew, Merryton, Hamilton, N.B.; sire, "Prince of Wales (673); dam, "Mailie," by Lochend Champion" (448).

EDWARD and ALFRED STANFORD, Eatons, Ashurst, Steyning, Sussex: THIRD PRIZE, 5*l.*, for "Barbara," bay; bred by themselves; sire, "Young Topsman" (1038); dam, "Bella," by "The Duke" (860).

Suffolk Fillies foaled in the Year 1879.

NATHANIEL CATCHPOLE, Bank House, St. Mary Key, Ipswich, Suffolk: FIRST PRIZE, 15*l.*, for his chestnut: bred by himself; sire, "Cant's Horse;" dam, "Donyland Pride," by "Cupbearer 2nd."

SAMUEL TOLLER, Letheringham Lodge, Wickham Market: SECOND PRIZE, 10*l.*, for "Dandy," chestnut; bred by himself; sire, "Statesman" (657); dam, "Scot 3rd" (932), by "Cupbearer 1st" (416).

SIR RICHARD WALLACE, Bart., K.C.B., M.P., Sudbourn Hall, Wickham Market, Suffolk: THIRD PRIZE, 5*l.*, for "Jessie," chestnut: bred by himself; sire, "Prince Imperial" (1239); dam, "Brag;" and the *Reserve Number* and *Highly Commended* for "Pearl," chestnut; both bred by himself; sire, "Prince Imperial" (1239); dam, "Diamond."

Suffolk Fillies foaled in the Year 1880.

ALFRED J. SMITH, Rendlesham, Woodbridge: FIRST PRIZE, 15*l.*, for "Duchess," chestnut; bred by himself; sire, "Duc de Paris" (1357); dam, "Rendlesham Darby" (838), by "Grout's Emperor" (644).

THE DUKE OF HAMILTON AND BRANDON, K.T., Easton Park, Wickham Market: SECOND PRIZE, 10*l.*, for "S. B.," chestnut; bred by himself; sire, "Statesman;" dam, "Belle of the Ball," by "Son of May Duke."

JAMES TOLLER, Blaxhall, Wickham Market: THIRD PRIZE, 5*l.*, for "Echo," chestnut; bred by himself; sire, "Cupbearer 3rd" (566); dam, "Empress" (914), by "Farmer" (396).

SIR RICHARD WALLACE, Bart., K.C.B., M.P., Sudbourn Hall, Wickham Market, the *Reserve Number* and *Highly Commended* for "Dora," chestnut; bred by himself; sire, "Prince Imperial;" dam, "Lily."

Pairs of Agricultural Horses (Mares or Geldings) foaled previously to the Year 1878. *

THE DUKE OF HAMILTON AND BRANDON, K.T., Easton Park, Wickham Market, Suffolk: FIRST PRIZE, 20*l.*, for "Belle of the Ball," chestnut mare; was foaled in 1874; bred by Mr. C. Frost, Wherstead, Ipswich, Suffolk; sire, "Son of May Duke;" dam by "Hero." "Yellow Diamond," chestnut mare; was foaled in 1877; bred by himself; sire, "Frost's Cupbearer II.;" dam, "Bright Diamond," by "Wolton's Monarch."

Agricultural Mares or Geldings foaled in the Year 1878.*

EDWARD DENT, Fernacres, Fulmer, Slough, Bucks: FIRST PRIZE, 15*l.*, for "Daisy," chestnut mare; bred by himself; sire, "Farmer's Glory;" dam, "Violet."

Agricultural Geldings foaled in the Year 1879.*

ALFRED HENRY CLARK, Moulton Eaugate, Spalding, Lincolnshire: FIRST PRIZE, 15*l.*, for "Champion," bay; bred by Mr. M. Yarard, Pinchbeck, Spalding, Lincolnshire; sire, "Lofty."

EDWARD OSMOND, Woodrow, Exeter, Devon: SECOND PRIZE, 10*l.*, for "Derby," iron grey; bred by Mr. W. Garratt, Derby; sire, "William the Conqueror" (2343); dam, by "Styche's Champion" (419).

*Agricultural Geldings foaled in the Year 1880.**

THOMAS MESSINGER, Bradden, Towcester, Northamptonshire: FIRST PRIZE, 15*l.*, for "Captain," chestnut; breeder unknown.

WILLIAM HEWER, Sevenhampton, Highworth, Wiltshire: SECOND PRIZE, 10*l.*, for his chestnut; bred by Mr. R. Sharps, South Marston, Swindon, Wilts; sire, "Guy of Warwick" (2588); dam, by "Noble" (2468).

THE MARCHIONESS OF DOWNSHIRE, Easthampstead Park, Wokingham, Berks: the *Reserve Number* and *Highly Commended* for her brown; bred by herself.

*Hunter Mares or Geldings up to 15 stone, Five Years old and upwards.**

JOHN ANGER, Ashbury, Shrivenham, Berks: FIRST PRIZE, 30*l.*, for "Lincoln," chestnut gelding; was foaled in 1877; bred by Mr. J. Thatcher, Uffington, Faringdon, Berks; sire, "Bosworth;" dam, "Lady Mary," by "Honest John."

JOHN GROUT, Woodbridge, Suffolk: SECOND PRIZE, 15*l.*, for "The Cardinal," chestnut gelding; was foaled in 1877; bred by Mr. Robertson, Loddon, Norfolk; sire, "Norfolk Jack."

THOMAS C. GARTH, Haines Hill, Twyford, Berks: THIRD PRIZE, 10*l.*, for "Emperor," brown gelding; was foaled in 1877; bred by himself; sire, "Lambkith;" dam, "Empress," by "Grey Prince."

ROBERT TOMPKINS, Reading: the *Reserve Number* to "Telephone," brown gelding; was foaled in 1875; breeder unknown; sire, "Leamington."

*Hunter Mares or Geldings up to 12 stone, Five Years old and upwards.**

JOHN RUTHERFORD, Summer Hill, Annan, N.B.: FIRST PRIZE, 25*l.*, for "Shamrock," bay gelding; was foaled in 1875; breeder unknown; sire, "Lord Ronald."

ROBERT TOMPKINS, Reading: SECOND PRIZE, 15*l.*, for "The Baron," brown gelding: was foaled in 1876; breeder unknown; sire, "Baron Cavendish;" dam by "All Fours."

CAPTAIN THWAITES, Heaton, Bradford, Yorks: THIRD PRIZE, 10*l.*, for "Royal Monarch," chestnut gelding; was foaled in 1875; breeder unknown; sire, "Monarch of the Glen;" dam by "Macaroni."

ROBERT T. HODGE, Wyfold Court, Henley-on-Thames: the *Reserve Number* to "Brown Duck," brown mare; was foaled in 1875; breeder unknown; sire, "The Drake."

*Hunter Mares foaled in the Year 1878.**

THOMAS C. GARTH, Haines Hill, Twyford, Berks: FIRST PRIZE, 20*l.*, for "Shepherdess," bay; bred by himself; sire, "Lambkith;' dam, "Arbutha," by "Arbuthen."

Hunter Geldings foaled in the Year 1878.*

JOHN LETT, The Firs, Scampston, York: FIRST PRIZE, 20*l.*, for "Laird o' the Glen," bay; bred by Mr. J. Smith, Gyll Hall, Catterick, Yorks; sire, "Glenfillan;" dam by "Cain."

EDWARD A. SANDERS, Stoke House, Exeter: SECOND PRIZE, 10*l.*, for "Nutmeg," brown; bred by himself; sire, "Nutpecker;" dam, "Sensation."

CHARLES C. HAYWARD, Southill, Biggleswade, Beds: THIRD PRIZE, 5*l.*, for "Citadel," chestnut; breeder unknown; sire, "Citadel."

Hunter Mares foaled in the Year 1879.*

JOHN HARGREAVES, Maiden Erlegh, Reading: FIRST PRIZE, 15*l.*, for "Bedgown," roan; bred by himself; sire, "Marquis of Townshend;" dam, "Birch."

RUSSELL SWANWICK, Royal Agricultural College Farm, Cirencester: SECOND PRIZE, 10*l.*, for his chestnut; bred by himself; sire, "John Davis;" dam, "Pet."

WILLIAM PARKER, Great Stanney Hall, Chester: the *Reserve Number* to "Maybloom," bay; bred by himself; sire, "The Shah;" dam, "Fanny," by "Old Calabar."

Geldings foaled in the Year 1879.*

RUSSELL SWANWICK, Royal Agricultural College Farm, Cirencester: FIRST PRIZE, 15*l.*, for "Montrose," chestnut; bred by himself; sire, "John Davis;" dam, "Minona," by "Lord of the Isles."

THOMAS C. GARTH, Haines Hill, Twyford, Berks: SECOND PRIZE, 10*l.*, for "Citadel," chestnut; bred by himself; sire, "Kars;" dam, "Arbutha," by "Arbuthen."

JOHN GROUT, Woodbridge, Suffolk: the *Reserve Number* to "Lincoln," brown; bred by Mr. Weightman, Manor House, Sinnington, Yorks; sire, "Conductor."

Hackney Mares or Geldings, not exceeding 15 *hands* 2 *inches, up to not less than* 15 *stone.**

JOHN RUTHERFORD, Summer Hill, Annan, N.B.: FIRST PRIZE, 20*l.*, for "Scottish Queen," grey mare; was foaled in 1876; bred by Mr. W. Collinson, Otteringham, Hull; sire, "Lord Derby 2nd."

ROBERT TOMPKINS, Reading: SECOND PRIZE, 10*l.*, for "Troubadour," grey gelding; was foaled in 1876; breeder unknown; sire, "Bass Rock."

THOMAS F. ARMSTRONG, 5, Portland Place, Shirley, Southampton: the *Reserve Number* to "Nellie par Nell," roan mare; was foaled in 1879; breeder unknown.

Hackney Mares or Geldings, not exceeding 15 *hands* 2 *inches, up to not less than* 12 *stone.**

WILLIAM FOSTER, Grove House, Pontefract, Yorkshire: FIRST PRIZE, 20*l.*, for "Water Lily," dark chestnut mare; was foaled in 1876; bred by Mr. W. Rickall, Warter Wold, Pocklington, Yorkshire; sire, "Denmark;" dam by "General Giles."

ROBERT TOMPKINS, Reading: SECOND PRIZE, 10*l.*, for "Titmouse," bay mare; was foaled in 1877; breeder unknown; sire, "Birdhill."

JOHN ANGER, Ashbury, Shrivenham, Berks: THIRD PRIZE, 5*l.*, for "Cock Robin," chestnut gelding; was foaled in 1877; bred by Mr. W. M. Tagg, Stanford, Faringdon, Berks.

GEORGE J. W. FLOWER, The Borough House, Yeovil, Somersetshire: the *Reserve Number* to "Norah Creina," bay mare; was foaled in 1876; bred by Mr. Sampson, Wyke Farm, Sherborne, Dorset; sire, "Alderman."

Hackney Mares or Geldings, above 13 *hands* 2 *inches, and not exceeding* 14 *hands* 2 *inches.**

WILLIAM FOSTER, Grove House, Pontefract, Yorkshire: FIRST PRIZE, 20*l.*, for "Lady of the Lake," chestnut mare; was foaled in 1876; bred by Mr. J. P. Crompton, Thornholme, Burton Agnes, Hull; sire, "Denmark;" dam by "St. Giles."

JOHN GROUT, Woodbridge, Suffolk: SECOND PRIZE, 10*l.*, for "Fanny," black mare; was foaled in 1877; breeder unknown.

CAPTAIN F. E. CALDWELL, Candover House, Alresford, Hants: THIRD PRIZE, 5*l.*, for "Turtledove," bay gelding; aged; breeder unknown.

Hackney Mares or Geldings, not exceeding 13 *hands* 2 *inches.**

WILLIAM POPE, Downham Market, Norfolk: FIRST PRIZE, 20*l.*, for "Speculation," bay mare; was foaled in 1873; bred by Mr. Wilson, Kendal, Westmoreland; sire, "Sir George."

APTAIN THWAITES, Heaton, Bradford, Yorkshire: FIRST PRIZE, 20*l.*, for "Fashion," black gelding; was foaled in 1875; breeder unknown: and SECOND PRIZE, 10*l.*, for "Novelty," brown gelding, aged; breeder unknown.

THE HON. EDGAR B. GIFFORD, Pedington Manor, Berkeley, Gloucestershire: the *Reserve Number* to "Peter," chestnut gelding; was foaled in 1877; breeder unknown.

CATTLE.

Shorthorn Bulls calved in either 1876, 1877, *or* 1878.

WILLIAM ISAAC PALMER, Grazeley Court, Reading: FIRST PRIZE, 20*l.*, for "Caractacus" (42,879), roan; was calved October 13th, 1878; bred by Mr. D. H. Mytton, Garth Hall, Welshpool; sire, "Constantine 2nd" (33,439); dam, "Joyce," by "Vespasian" (32,759); g. d., "Gem," by "Berwick" (23,411); gr. g. d., "Glossary 2nd," by "Hardware" (19,919); gr. g. g. d., "Glossary," by "Hazel" (26,352).

EDWIN BRISTOL, North Hayes, Motcombe, Shaftesbury, Dorsetshire: SECOND PRIZE, 10*l.*, for "Osmanli," white; was calved June 30th, 1877; bred by Mr. T. Hewer, Inglesham, Lechlade, Gloucestershire; sire, "King Lear" (34,325); dam, "Lisette," by "Emperor" (31,108); g. d., "Red Cow," by "Alderman" (23,295); gr. g. d., "No. 80," by "Candidate" (30,647); gr. g. g. d., "No. 7," by "Garrick" (17,939).

WILLIAM HANDLEY, Green Head, Milnthorpe, Westmoreland: THIRD PRIZE, 5*l.*, for "Master Harbinger" (40,324), roan; was calved November 18th, 1877; bred by himself; sire, "Alfred the Great" (36,121); dam, "Earl's Flora," by "Earl of Eglinton" (23,832); g. d., "Flora Cobham," by "Marquis of Cobham" (22,299); gr. g. d., "Flower of Fitz-Clarence," by "Alfred Fitz-Clarence" (19,215); gr. g. g. d., "Miss Nicety," by "Veteran" (13,941).

THE MARQUIS OF EXETER, Burghley House, Stamford: the *Reserve Number* and *Highly Commended* for "Great Northern Diver," roan; was calved June 17th, 1878; bred by himself; sire, "Earl of Geneva" (33,794); dam, "Gannet," by "Telemachus" (27,603); g. d., "Seagull," by "Nestor" (24,648); gr. g. d., "Petrel," by "Fourth Duke of Thorndale" (17,750); gr. g. g. d., "Sandpiper," by "The Briar" (15,376).

Shorthorn Bulls calved in the Year 1879.

JOHN OUTHWAITE, Bainesse, Catterick, Yorkshire: FIRST PRIZE, 20*l.*, for "Lord Zetland," roan (43,596); was calved April 12th; bred by the Earl of Zetland, Aske Hall, Richmond, Yorkshire; sire, "Royal Windsor" (29,890); dam, "Florella," by "George Peabody" (28,710); g. d., "Floss," by "Windsor Augustus" (19,157); gr. g. d., "Flirt," by "Cobham" (14,287); gr. g. g. d., "Wood Nymph," by "Ravensworth" (10,681).

RICHARD STRATTON, The Duffryn, Newport, Monmouthshire: SECOND PRIZE, 10*l.*, for "Rover" (43,924), roan; was calved May 12th; bred by Mr. Joseph Stratton, Alton Priors, Marlborough, Wilts; sire, "Proteus" (40,552); dam, "Rosebud," by "Royal" (35,331); g. d., "May Rose 2nd," by "Bude Light" (21,342); gr. g. d., "May Rose," by "Young Windsor" (17,241); gr. g. g. d., "Essence of Roses," by "His Highness" (14,708).

LORD BRAYBROOKE, Audley End, Saffron Walden, Essex: THIRD PRIZE, 5*l.*, for "Duke Oneida" (43,151), red; was calved January 19th; bred by Mr. J. Rigg, Wrotham Hill Park, Sevenoaks, Kent; sire, "Duke of Ormskirk" (36,526); dam, "Waterloo of Oneida," by "Sixth Duke of Oneida" (30,997); g. d., "Waterloo 37th," by "Oxford Beau" (29,485); gr. g. d., "Waterloo 30th," by "Third Duke of Wharfdale" (21,619); gr. g. g. d., "Waterloo 25th," by "Duke of Geneva" (19,614).

ROBERT THOMPSON, Inglewood Bank, Penrith, Cumberland: the *Reserve Number* and *Highly Commended* for "Beau Benedict" (42,769), roan; was calved February 2nd; bred by Mr. W. Linton, Sheriff Hutton, York; sire, "Paul Potter" (38,854); dam, "Home Beauty," by "Mountain Chief" (20,383); g. d., "Hand-Maid," by "May-Day" (20,323); gr. g. d., "White Rose," by "Magnus Troil" (14,880); gr. g. g. d., "Miss Henderson," by "Magnus Troil" (14,880).

Shorthorn Bulls calved in the Year 1880.

FRANCIS JOHN SAVILE FOLJAMBE, M.P., Osberton Hall, Worksop, Notts: FIRST PRIZE, 20*l.*, for "Bright Helm" (44,455), white; was calved February 3rd; bred by himself; sire, "Titan" (35,085); dam, "Bright Duchess," by "Grand Duke 15th" (21,852); g. d., "Bright Halo," by "Breast Plate" (19,337); gr. g. d., "Bright Dew," by "British Prince" (14,197); gr. g. g. d., "Bright Morn," by "Vanguard" (10,994).

WILLIAM HENRY WAKEFIELD, Sedgwick, Kendal, Westmoreland: SECOND PRIZE, 10*l.*, for "Baron Sedgwick" (44,373), roan; was calved January

30th; bred by himself; sire, "Baron Barrington 4th" (33,006); dam, "Well Heads Rose 2nd," by "Sir Arthur Windsor" (35,541); g. d., "Well Heads Rose," by "Dunrobin" (28,486); gr. g. d., "Rosebud 2nd," by "Albert Victor" (23,293); gr. g. g. d., "Rosebud 1st," by "Squire Stuart" (20,891).

H.R.H. THE PRINCE OF WALES, K.G., Sandringham, Norfolk: THIRD PRIZE, 5*l*., for "Harry Hotspur" (44,922), roan; was calved December 13th; bred by His Royal Highness; sire, "Baron Ryedale" (37,813); dam, "Honey 64th," by "Duke of Hillhurst" (28,401); g. d., "Honey 39th," by "Third Duke of Clarence" (23,727); gr. g. d., "Honey 20th," by "Duke of Wharfdale" (19,648); gr. g. g. d., "Honeybee," by "Chaff-cutter" (12,572).

CHARLES WILLIAM BRIERLEY, Rosedale, Tenbury, Worcestershire: the *Reserve Number* and *Highly Commended* for "Rosedale Oxford," red and white; was calved September 5th; bred by himself; sire, "Oxford Duke 10th" (38,830); dam, "Bridal Veil," by "Lord George" (29,107); g. d., "Orange Blossom," by "Albion" (25,500); gr. g. d., "Bride Elect," by "Second Duke of Cumberland" (23,735); gr. g. g. d., "Bridesmaid," by "Fourth Duke of Thorndale" (17,750).

Shorthorn Bulls calved in the Year 1881.

BENJAMIN ST. JOHN ACKERS, Prinknash Park, Painswick, Gloucestershire: FIRST PRIZE, 20*l*., for "Trojan," red and white; was calved April 19th; bred by himself; sire, "Lord Prinknash 2nd" (38,653); dam, "Lady Helen," by "Knight of the Forest" (31,556); g. d., "La Belle Hélène," by "Prince of the Empire" (20,578); gr. g. d., "Lady Eleanor," by "Sir Roger" (16,991); gr. g. g. d., "Lady Sarah," by "Baron Warlaby" (7813).

WILLIAM HANDLEY, Green Head, Milnthorpe, Westmoreland: SECOND PRIZE, 10*l*., for "Sir Arthur Ingram 2nd," roan; was calved January 5th; bred by himself; sire, "Sir Arthur Ingram" (32,490); dam, "Rose Mary," by "Sir Arthur Windsor" (35,541); g. d., "Louisa," by "Sir Walter Trevelyan" (25,179); gr. g. d., "Old Lavender," by "General Garibaldi" (21,813); gr. g. g. d., "Lady," by "Tenant Farmer" (13,828).

SIR HENRY HUSSEY VIVIAN, Bart., M.P., Park Le Breos, Swansea, Glamorganshire: THIRD PRIZE, 5*l*., for "Pearl Dealer," roan; was calved July 23rd; bred by himself; sire, "Pearl Finder" (43,744); dam, "Mabel," by "James 1st" (24,202); g. d., "Miranda," by "Knight of the Lagan" (20,083); gr. g. d., "Moss Rose 4th," by "Hickory" (14,706); gr. g. g. d., "Moss Rose," by "Phœnix" (6290).

FRANCIS JOHN SAVILE FOLJAMBE, M.P., Osberton Hall, Worksop, Notts: the *Reserve Number* and *Highly Commended* for "Andrew Fairservice," red and white; was calved June 29th; bred by himself; sire, "Sir Andrew" (42,387); dam, "November Rose," by "M. P." (29,398); g. d., "China Rose," by "Cambridge Duke 4th" (25,706); gr. g. d., "Clematis," by "Sir John" (12,084); gr. g. g. d., "Clementina," by "Clementi" (3399).

Shorthorn Cows, in-milk or in-calf, calved previously to or in the Year 1878.

TEASDALE HILTON HUTCHINSON, Manor House, Catterick, Yorkshire: FIRST PRIZE, 20*l*., for "Gainful," roan; was calved October 22nd, 1877; in-milk;

calved December 8th, 1881, and in-calf; bred by himself; sire, "King Alfonso" (36,832); dam, "Grateful," by "M. C." (31,898); g. d., "Gerty 3rd," by "Knight of the Shire" (26,552); gr. g. d., "Gerty," by "Vain Hope" (23,102); gr. g. g. d., "Garland," by "Grand Master" (24,078).

Jonathan Peel, Knowlmere Manor, Clitheroe, Yorkshire: Second Prize, 10*l.*, for "Casquette," roan; was calved September 2nd, 1878; in-milk; calved February 13th, 1882; bred by Mr. W. S. Woodroffe, Beaumont Grange, Lancaster; sire, "Knight of Knowlmere 2nd" (31,542); dam, "Cosette 8th," by "Baron Stackhouse" (30,488); g. d., "Cosette 4th," by "The Premier" (27,640); gr. g. d., "Cosette 2nd," by "Columbus 2nd" (17,588); gr. g. g. d., "Cosette," by "Coriolanus" (12,638).

Teasdale Hilton Hutchinson, Manor House, Catterich: Third Prize, 5*l.*, for "Gratia," roan; was calved October 7th, 1878; in-milk; calved January 6th, 1882, and in-calf; bred by himself; sire, "Pluto" (35,050); dam, "Gratification," by "M. C." (31,898); g. d., "Gerty 3rd," by "Knight of the Shire" (26,552); gr. g. d., "Gerty," by "Vain Hope" (23,102); gr. g. g. d., "Garland," by "Grand Master" (24,078).

Charles William Brierley, Rosedale, Tenbury, Worcestershire: the *Reserve Number* and *Highly Commended* for "Snowflake," white; was calved September 11th, 1878; calved July 13th, 1881, and in-calf; bred by himself; sire, "Bolivar's Farewell" (33,173); dam, "Bolivar's White Tulip," by "Bolivar" (25,649); g. d., "Tulip Flower," by "Lord Albert" (20,143); gr. g. d., "Rachel," by "Monarch" (18,412); gr. g. g. d., Young Matchless," by "Duke of Tyne" (12,773).

Shorthorn Cows or Heifers, in-milk or in-calf, calved in the Year 1879.

David Pugh, Manoravon, Llandilo, Carmarthenshire: First Prize, 20*l.*, for "Czarina Manoravon," roan; was calved July 25th; in-milk; calved February 17th, 1882, and in-calf; bred by himself; sire, "Falmouth" (38,268); dam, "Czarina 11th," by "Sir Hildebrand" (29,993); g. d., "Czarina 9th," by "Falconer" (23,907); gr. g. d., "Czarina 5th," by "Earl of Elgin" (21,642); gr. g. g. d., "Zoe," by "Prince William" (20,607).

Benjamin St. John Ackers, Prinknash Park, Painswick: Second Prize, 10*l.*, for "Lady Georgina Newcomb," rich roan; was calved July 29th; in-milk; calved January 1st, 1882, and in-calf; bred by himself; sire, "Lord Prinknash 2nd" (38,653); dam, "Lady Georgina Turbitt," by "County Member" (28,268); g. d., "Patience Heatherstone," by "British Crown" (21,322); gr. g. d., "Virtue," by "Valasco" (15,443); gr. g. g. d., "Lady Georgina," by "Knight Errant" (18,154).

John Jervis Sharp, Broughton, Kettering, Northamptonshire: Third Prize, 5*l.*, for "May Duchess 15th," red; was calved June 21st; in-milk; calved April 26th, 1882; bred by himself; sire, "Duke of Darlington 4th" (38,138); dam, "May Duchess 14th," by "Imperial Oxford" (36,785); g. d., "May Duchess 11th," by "Earl of Oxford" (21,651); gr. g. d., "May Duchess 4th," by "Earl of Oxford" (21,651); gr. g. g. d., "May Duchess," by "Grand Duke of York" (12,966).

The Rev. Robert Bruce Kennard, Marnhull, Blandford, Dorset: the *Reserve Number* and *Highly Commended* for "Blossom 5th," roan; was calved July 31st; in-calf; bred by himself; sire, "Lord Fitz-Clarence 24th" (40,163); dam, "Blossom 3rd," by "Grand Duke of Oxford"

(28,763); g. d., "Blossom," by "Earl of Darlington" (21,636); gr. g. d., "Belinda," by "Sir Roger" (16,991); gr. g. g. d., "Berrington Lass," by "Sir Walter 2nd" (10,834).

Shorthorn Heifers calved in the Year 1880.

BENJAMIN ST. JOHN ACKERS, Prinknash Park, Painswick, Gloucestershire: FIRST PRIZE, 20*l.*, for "Lady Carew 9th," red and little white; was calved November 11th; bred by himself; sire, "Lord Prinknash 2nd" (38,653); dam, "Lady Carew 3rd," by "County Member" (28,268); g. d., "Lady Jane," by "Baron Killerby" (23,364); gr. g. d., "Miracle," by "Prince James" (20,554); gr. g. g. d., "Heather Bell," by "Hero" (18,055).

WILLIAM HOSKEN and SON, Loggan's Mill, Hayle, Cornwall: SECOND PRIZE, 10*l.*, for "Gertrude 5th," roan; was calved August 19th; in-calf; bred by themselves; sire, "Grand Duke 34th" (41,642); dam, "Gertrude 2nd," by "Duke of Oxford" (31,005); g. d., "Gertrude," by "Second Earl of Oxford" (23,844); gr. g. d., "Grateful," by "Thorndale Mason" (23,067); gr. g. g. d., "Graceful," by "Prince Frederick" (16,734).

JONATHAN PEEL, Knowlmere Manor, Clitheroe, Yorkshire: THIRD PRIZE, 5*l.*, for "Clara Regia," red; was calved June 6th; bred by himself; sire, "Royal Stuart" (40,646); dam, "Claribel," by "Janus" (34,245); g. d., "Clara Dea," by "K. C. B." (26,492); gr. g. d., "Clara," by "Fitz-Clarence" (14,552); gr. g. g. d., "Georgie," by "Prince George" (13,510).

DAVID PUGH, Manoravon, Llandilo, Carmarthenshire: the *Reserve Number* and *Highly Commended* for "Czarina Manoravon 2nd," white; was calved August 4th; in-calf; bred by himself; sire, "Falmouth" (38,268); dam, "Czarina 11th," by "Sir Hildebrand" (29,993); g. d., "Czarina 9th," by "Falconer" (23,907); gr. g. d., "Czarina 5th," by "Earl of Elgin" (21,642).

Shorthorn Heifers calved in the Year 1881.

TEASDALE HILTON HUTCHINSON, Manor House, Catterick, Yorkshire: FIRST PRIZE, 20*l.*, for "Lady Pamula," roan; was calved March 17th; bred by himself; sire, "British Knight" (33,220); dam, "Lady Pateley," by "Vehement" (35,853; g. d., "Lady Nidderdale," by "Merry Monarch" (22,349); gr. g. d., "Lady Fly," by "Champion" (23,520); gr. g. g. d., "Purity," by "Perfection" (27,059).

SIR JOHN HENRY GREVILLE SMYTH, Bart., Ashton Court, Bristol: SECOND PRIZE, 10*l.* for "Ashton Winsome 3rd," roan; was calved July 21st; bred by himself; sire, "Wild Oxonian" (40,927); dam, "Ashton Winsome," by "Duke of Glo'ster 7th" (39,735); g. d., "Winsome 20th," by "Fifth Duke of Wetherby" (31,033); gr. g. d., "Lady Wild Eyes 3rd," by "Seventh Duke of York" (17,754); gr. g. g. d., "Bright Eyes 2nd," by "Royal Butterfly 3rd" (18,754).

MAJOR CHAFFEY, Prince Hill, Worton, Devizes, Wilts: THIRD PRIZE, 5*l.*, for "Wild Duchess of Rosedale," red and white; was calved January 22nd; bred by himself; sire, "Duke of Rosedale 8th" (39,780); dam, "Wild Duchess of Geneva 5th," by "Ninth Duke of Geneva" (28,391); g. d., "Wild Duchess of York," by "Seventh Duke of York" (17,754); gr. g. d., "Wild Oxford," by "Lord Oxford 2nd" (20,215); gr. g. g. d., "Wild Eyes 24th," by "Lord Barrington 3rd" (16,382).

Sir Henry Hussey Vivian, Bart., M.P., Park le Breos, Swansea, Glamorganshire: the *Reserve Number* and *Highly Commended* for "Maid of Glamorgan," roan; was calved March 14th; bred by himself; sire, "Rover" (43,924); dam, "Maiden," by "Eighth Duke of York" (23,808); g. d., "Mabel," by "James 1st" (24,202); gr. g. d., "Miranda," by "Knight of the Lagan" (20,083); gr. g. g. d., "Moss Rose 4th," by "Hickory" (14,706).

Hereford Bulls calved in either 1876, 1877, *or* 1878.

Frederick Platt, Barnby Manor, Newark, Notts: First Prize, 20*l.*, for "Horace 4th;" was calved July 17th, 1878; bred by himself; sire, "Horace" (3877); dam, "Nutty," by "Cholstrey" (1918); g. d., "Nutty," by "Lord Clyde" (2084); gr. g. d., by "Son of Kohinoor" (825).

The Earl of Coventry, Croome Court, Severn Stoke, Worcestershire: Second Prize, 10*l.*, for "Fisherman" (5913); was calved May 25th, 1878; bred by Mr. T. Rogers, Coxhall; sire, "Conservator" (5265); dam, "Beauty," by "Langdale" (3203); g. d., "Cockey," by "Energy" (1982); gr. g. d. by "Kinlet" (1293).

Henry William Taylor, Showle Court, Ledbury, Herefordshire: the *Reserve Number* to "Trafalgar" (6230); was calved September 11th, 1878; bred by the late Mr. W. Taylor, Showle Court; sire, "Thoughtful" (5063); dam, "Monkton Beauty 3rd," by "Mercury" (3967); g. d., "Beauty," by "Sir Francis" (3438); gr. g. d., "Beauty," by "Holmer" (2043).

Hereford Bulls calved in the Year 1879.

Herbert Richard Hall, Holme Lacey, Hereford: First Prize, 20*l.*, for "Defender" (5866); was calved May 20th; bred by Mr. H. Mason, Comberton, Ludlow; sire, "Commander" (4452); dam, "Miss Rogers," by "Zurich" (5175); g. d., "Broady 2nd," by "Sir George" (3439); gr. g. d., "Broady," by "Cantab" (717).

John Morris, Lulham-Madley, Hereford: Second Prize, 10*l.*, for "Tennis" (6218); was calved November 30th; bred by Mr. J. Lewis, The Lower Hill, Hereford; sire, "Telescope" (5630); dam, "Dolly," by "Banquo" (3667); g. d., "Madeline," by "Original" (2660); gr. g. d., "Lassie," by "Greengage" (1266).

Sir Joseph Russell Bailey, Bart., M.P., Glanusk Park, Crickhowell, Breconshire: the *Reserve Number* and *Commended* for "Velocipede" (6241); was calved October 1st; bred by Mr. J. Morris, Lulham-Madley; sire, "Volunteer" (5685); dam, "Browny," by "The Sabre" (3527); g. d., "Nutty 2nd," by "Interest" (2046); gr. g. d., "Old Nutty," by "Greengage" (1266).

Hereford Bulls calved in the Year 1880.

Aaron Rogers, The Rodd, Kington, Herefordshire: First Prize, 20*l.*, for "Archibald" (16,290); was calved May 3rd; bred by himself; sire, "Dolly" (5875); dam, "Miss Chance 3rd," by "Grateful" (4622); g. d., "Miss Chance 2nd," by "Stanway" (2790); gr. g. d., "Miss Chance," by "Gratitude" (3147).

Thomas James Carwardine, Stockton Bury, Leominster, Herefordshire: Second Prize, 10*l.*, for "Sir Bartle Frere;" was calved July 4th; bred

by himself; sire, "Lord Wilton" (4740); dam, "Tiny," by "Longhorns" (4711); g. d., "Rosebud," by "De Cote" (3060); gr. g. d., "Stately," by "Heart of Oak" (2035).

ALLEN EDWARDS HUGHES, Wintercott, Leominster, Herefordshire: THIRD PRIZE, 5*l.*, for "Rudolph;" was calved August 1st; bred by Mr. P. Turner, The Leen, Pembridge; sire, "The Grove 3rd" (5051); dam, "Primrose 2nd," by "Spartan" (5009); g. d., "Primrose," by "Dauphin" (5058); gr. g. d., "Daffodil," by "Bachelor" (2941).

Hereford Bulls calved in the Year 1881.

JOHN PRICE, Court House, Pembridge, Herefordshire: FIRST PRIZE, 20*l.*, for "Garfield;" was calved March 27th; bred by himself; sire, "Quickset" (6127); dam, "Plumb 3rd," by "Challenge" (3005); g. d., "Plumb," by "North Star" (2134); gr. g. d. "Plumb," by "Havelock" (1609).

THOMAS JAMES CARWARDINE, Stockton Bury, Leominster: SECOND PRIZE, 10*l.*, for "Chippendale;" was calved March 28th; bred by himself; sire, "Lord Wilton" (4740); dam, "Judy," by "Rodney" (4907); g. d., "Verbena," by "De Cote" (3060); gr. g. d., "Lofty," by "Heart of Oak" (2035).

WILLIAM TUDGE, Leinthall, Ludlow: THIRD PRIZE, 5*l.*, for "Prince Rose;" was calved October 20th; bred by himself; sire, "Westonbury" (6254); dam, "Roseleaf," by "Lord Hythe" (3937); g. d., "Rosebud," by "Sir Thomas" (2228); gr. g. d., "Rose," by "North Star" (2138).

HERBERT RICHARD HALL, Holme Lacey, Hereford: the *Reserve Number* to "Holme Tredegar;" was calved July 4th; bred by himself; sire, "Dale Tredegar" (5856); dam, "Dahlia 2nd," by "Patentee" (4003); g. d., "Dahlia," by "Artist" (2934); gr. g. d., "Comely," by "Major" (2629).

Hereford Cows, in-milk or in-calf, calved previously to or in the Year 1878.

HENRY WILLIAM TAYLOR, Showle Court, Ledbury, Herefordshire: FIRST PRIZE, 15*l.*, for "Modesty;" was calved August 14th, 1875, calved June 17th, 1881, and in-calf; bred by the late Mr. W. Taylor, Showle Court; sire, "Tredegar" (5077); dam, "Lovely," by "Tenant Farmer" (2806); g. d., "Browny," by "Twin" (2284).

WILLIAM TUDGE, Leinthall, Ludlow: SECOND PRIZE, 10*l.*, for "Mermaid;" was calved March 19th, 1877; calved August 14th, 1881, and in-calf; bred by Mr. S. Robinson, Lynhales, Kington; sire, "Regulus" (4076); dam, "Mermaid," by "Luxury" (3233); g. d., "Fairmaid 3rd," by "Douglas" (2505); gr. g. d., "Fairmaid 2nd," by "Master Butterfly" (1313).

JOHN MCLEOD PETLEY, The Green House, Bridgnorth, Salop: THIRD PRIZE, 5*l.*, for "Maid of the Teme;" was calved July 2nd, 1875; calved January 8th, 1881, and in-calf; bred by Mr. T. Fenn, Stonebrook House, Ludlow; sire, "Silver Chief" (4952); dam, "Lady of the Teme," by "Severus 2nd" (2747); g. d., "Victoria," by "Wilson" (4250); gr. g. d., by "Havelock" (1609).

THOMAS FENN, Stonebrook House, Ludlow: the *Reserve Number* and *Highly Commended* for "Lady Cotmore 2nd;" was calved May 9th, 1878; calved in November, 1881, and in-calf; bred by himself; sire, "Blakemere" (5227); dam, "Miss Cotmore," by "Cotmore" (4113); g. d.,

"Princess," by "Saturn" (1754); gr. g. d., "Whitehorn," by "Newton" (1667).

Hereford Cows or Heifers, in-milk or in-calf, calved in the Year 1879.

Henry William Taylor, Showle Court, Ledbury, Herefordshire: First Prize, 15*l*., for "Lorna Doone;" was calved July 25th; in-milk; calved March 20th, 1882; bred by the late Mr. Taylor, Showle Court; sire, "Horace" (3877); dam, "Monkton Beauty 3rd," by "Mercury" (3967); dam, "Beauty," by "Sir Francis" (3438); gr. g. d., "Beauty," by "Holmer" (2043).

Philip Turner, The Leen, Pembridge, Herefordshire: Second Prize, 10*l*., for "Silvia;" was calved July 29th; in-milk; calved January 15th, 1882; bred by himself; sire, "Corsair" (5271); dam, "Columbine," by "Silver Boy" (3419); g. d., "Exquisite," by "Provost" (4067); gr. g. d., "Norma," by "Bolingbroke" (1883).

Frederick Platt, Barnby Manor, Newark, Notts: Third Prize, 5*l*., for "Lady 7th;" was calved August 29th; in-calf; bred by himself; sire, "Horace" (3877); dam, "Lady 2nd," by "Orleton" (3293); g. d., "Lady," by "Cholstrey" (1918); gr. g. d., "Lady," by "Lord Clyde" (2084).

Hereford Heifers calved in the Year 1880.

Thomas James Carwardine, Stockton, Bury, Leominster: First Prize, 15*l*. for "Henrietta;" was calved August 6th; bred by himself; sire, "Lord Wilton" (4740); dam, "Rosetta," by "Sir Frank" (2762); g. d., "Sunflower," by "Heart of Oak" (2035); gr. g. d., "Slipper," by "Counsellor" (1939).

Allen Edward Hughes, Wintercott, Leominster, Herefordshire: Second Prize, 10*l*., for "Modesty;" was calved June 6th; bred by Mrs. Edwards, Wintercott; sire, "Commander" (4452); dam, "Maude," by "Royalist" (4921); g. d., "Young Mermaid 3rd," by "Leominster 3rd" (3211); gr. g. d., "Young Mermaid," by "Adforton" (1839).

William S. Powell, Eglwysnunydd, Taibach, Glamorganshire: Third Prize, 5*l*., for "Kathleen;" was calved March 7th; bred by himself; sire, "Spartan" (5009); dam, "Princess 6th," by "Brecon" (2430); g. d., "Princess 2nd," by "Brecon" (2974); gr. g. d., "Princess."

Hereford Heifers calved in the Year 1881.

Major Howarth Ashton, Manor House, Baldock, Herts: First Prize, 15*l*., for "Princess:" was calved January 26th; bred by Mr. T. Marston, Letton, Brampton Brian, Herefordshire; sire, "Marquis" (6057); dam, "Moss Rose," by "Avenger" (5198); g. d., "Cowslip," by "Reginald" (3380); gr. g. d., "Coxall" (3050).

Christopher James Searle, Trelewack, St. Ewe, St. Austell, Cornwall: Second Prize, 10*l*., for "Grand Duchess 2nd;" was calved June 15th; bred by himself; sire, "Grand Duke" (5342); dam, "Duchess of Cornwall," by "Cincinnatus" (3749); g. d., "Lady Golding," by "Golding" (3846); gr. g. d., "Letton Lass," by "Son of Plunder" (1038).

Thomas James Carwardine, Stockton Bury, Leominster: Third Prize, 5*l*., for "Venus 2nd;" was calved May 29th; bred by himself; sire, "Lord Wilton" (4740); dam, "Damsel," by "Longhorns" (4711); g. d., "Ethel," by "De Cote" (3060); gr. g. d., "Apology," by "Sir John 2nd" (3455).

FREDERICK PLATT, Barnby Manor, Newark, Notts: the *Reserve Number* and *Highly Commended* for "Prettymaid 4th;" was calved March 17th; bred by himself; sire, Hartington "(5358); dam, "Prettymaid," by "Horace" (3877); g. d., "Alice Grey 3rd," by "Sir Richard" (3460); gr. g. d., "Alice Grey 2nd," by "Marmaduke 2nd" (2632).

Hereford Cow and two of her offspring.†

ROBERT WILLIAM HALL, Ashton, Leominster: FIRST PRIZE, 20*l.*, for "Lovely 1st:" was calved March 31st, 1876; sire, "Preceptor" (4030); dam, "Vanity," by "Artist" (2934); g. d., "Dainty," by "Ashton" (1500); gr. g. d., "Nutty," by "Uncle Tom" (1107). "Theodora" and "Dorothea" were calved September 28th, 1881; sire, "Lord Wilton" (4740); all bred by himself.

THE EARL OF COVENTRY, Croome Court, Severn Stoke, Worcestershire: SECOND PRIZE, 10*l.*, for "Giantess;" was calved July 4th, 1872; sire, "Sir Roger" (4133); dam, "Haidee," by "Battenhall" (2406); g. d., "Diana," by "Carbonel" (1525); gr. g. d., "Young Dainty," by "The Doctor" (1083). "Britannia" was calved December 30th, 1875; sire, "The Doctor" (5045); both bred by Mr. Tudge, Adforton, Leintwardine. "Golden Treasure" was calved May 25th, 1878; sire, "Maréchal Niel" (4760); bred by himself.

JOHN MORRIS, Lulham Madley, Hereford: *Reserve Number* and *Highly Commended* for "Cambria 3rd;" was calved August 22nd, 1877; sire, "The Young Obadiah" (5652); dam, "Cambria," by "Stow" (3478); g. d., "Hampton," by "Interest" (2046); gr. g. d., "Noke," by "Dutiful" (1978). "Chatty" was calved April 4th, 1881; sire, "Marlborough" (5451). Bull calf was calved April 15th, 1882; sire, "Tennis" (6218); all bred by himself.

Devon Bulls calved in either 1876, 1877, *or* 1878.

VISCOUNT FALMOUTH, Tregothnan, Probus, Cornwall: FIRST PRIZE, 20*l.*, for "Sir Michael" (1646); was calved September 17th, 1877; bred by himself; sire, "Sirloin" (1443); dam, "Water Lily" (5050), by "Jonquil" (1131); g. d., "Watercress" (4006), by "Sunflower" (937); gr. g. d., "Cheesewring" (2572A), by "Protector" (711).

ALFRED C. SKINNER, Pound Farm, Bishops Lydeard, Taunton: SECOND PRIZE, 10*l.*, for "Fancy's Robin" (1556); was calved December 23rd, 1877; bred by himself; sire, "Master Robin" (1162); dam, "Fancy 3rd" (4478), by "Red Prince" (1432); g. d., "Fancy 1st" (4476); gr. g. d., "Fancy."

WILLIAM ROLLES FRYER, Lytchett Minster, Poole, Dorset: the *Reserve Number* to "Sweet William" (1650); was calved August 24th, 1878; bred by Viscount Portman, Bryanston, Blandford; sire, "Young Palmerston" (1251); dam, "Famous" (4450), by "Duke of Plymouth" (1080); g. d., "Famous;" gr. g. d., "Fruitful" (3524), by "Exeter" (1098).

Devon Bulls calved in the Year 1879.

VISCOUNT FALMOUTH, Tregothnan, Probus, Cornwall: FIRST PRIZE, 20*l.*, for "Plum Pudding;" was calved August 30th; bred by himself; sire, "Sirloin" (1443); dam, "Christmas Rose" (3280), by "Sunflower" (937); g. d., "Rosa Bonheur" (3009), by "Corrector" (809); gr. g. d., "Picture 4th" (2224), by "Davy's Napoleon 3rd" (464).

† Given by the Hereford Herd-Book Society.

HENRY DAVY, Penhole House, North Hill, Launceston, Cornwall: SECOND PRIZE, 10*l*., for "Harry 2nd;" calved June 5th; bred by himself; sire, "Agricola;" dam, Cowslip 2nd," by "Napoleon;" g. d., "Cowslip," by "Warrior;" gr. g. d., "Primrose," by "Prince of Oldenburg."

JOHN WALTER, M.P., Bearwood, Wokingham, Berks: THIRD PRIZE, 5*l*., for "Prettyface's Duke" (1627); was calved August 21st; bred by Mr. Walter Farthing, Stowey Court, Bridgwater, Somerset; sire, "Master Flitton" (1405); dam, "Prettyface" (3803), by "Lovely's Duke" (1152); g. d., "Prettyface" (3804), by "Sir George" (925).

Devon Bulls calved in the Year 1880.

SIR WILLIAM WILLIAMS, Bart., Heanton, Barnstaple, Devon: FIRST PRIZE, 20*l*., for "Duke of Flitton 17th;" was calved Sept. 30th; bred by Mrs. Langdon, Flitton Barton, North Molton, Devon; sire, "Sir Bevys;" dam, "Actress 13th," by "Young Palmerston;" g. d., "Actress 2nd," by "Duke of Flitton 3rd;" gr. g. d., "Actress 1st," by "Palmerston."

JOHN HOWSE, Leighland, Washford, Taunton, Somerset: SECOND PRIZE, 10*l*., for "Young Nelson;" was calved March 4th; bred by himself; sire, "Nelson" (1413); dam, "Starlight" (4970), by "Sir Roger" (1213); g. d., "Star" (4968); gr. g. d., "Rose" (3903).

JOHN WALTER, M.P., Bearwood, Wokingham, Berks: THIRD PRIZE, 5*l*., for "Sir John" (1645); was calved September 14th; bred by himself; sire, "Royal Aston" (1437); dam, "Young Dairymaid" (4018), by "Master Alic" (881); g. d., "Beauty" (1788), by "Davy's Napoleon" (464).

Devon Bulls calved in the Year 1881.

ALFRED C. SKINNER, Pound Farm, Bishops Lydeard, Taunton: FIRST PRIZE, 20*l*., for "Lord Currypool" (1589); was calved January 7th; bred by Mr. W. Farthing, Stowey Court, Bridgwater; sire, "Lord Stowey" (1601); dam, "Lady Currypool"' (5430), by "Profit's Duke" (1194): and SECOND PRIZE, 10*l*., for "Jumbo;" was calved October 19th; bred by himself: sire, "Fancy's Robin" (1556); dam, "Myrtle 3rd" (4767), by "Red Prince" (1432); g. d., "Myrtle 2nd" (4766); gr. g. d., "Myrtle 1st" (4765).

JOHN JACKMAN and RICHARD BICKLE, Bradstone Barton, Tavistock, Devon: THIRD PRIZE, 5*l*., for "Captain" (1518); was calved January 3rd; bred by themselves; sire, "Dolly's Duke" (1315); dam, "Beatrice 2nd" (3187), by "Earl of Hexworthy" (1091); g. d., "Beatrice" (2501), by "Garibaldi" (842); gr. g. d., "Beauty" (1786), by "Monarch" (460).

WILLIAM ROLLES FRYER, Lytchett Minster, Poole, Dorset: the *Reserve Number* to "Rose" (1638A); was calved February 20th; bred by Mr. R. B. Warren, Child Okeford, Blandford; sire, "Lord Taunton" (1397); dam, "Lovejoy" (3657), by "Viscount Portman" (1239); g. d., "Rusty" (3033), by "Prince of Wales" (910); gr. g. d., "Ruth" (3034), by "Lord Derby" (667).

Devon Cows, in-milk or in-calf, calved previously to or in the Year 1878.

JOHN BRADBEER, Pyrland Hall Farm, Taunton St. James, Somerset: FIRST PRIZE, 15*l*., for "Nellie;" was calved June 22nd, 1878; in-milk; calved April 2nd, 1882; bred by himself; sire, "Nelson;" dam "Young Queen."

JOHN WALTER, M.P., Bearwood, Wokingham, Berks: SECOND PRIZE, 10*l.*, for "Temptress 12th" (5005); was calved in June 1877; in-milk; calved Feb. 13th, 1882; bred by Mrs. Langdon, Flitton Barton, North Molton; sire, "Jonquil" (1131); dam, "Temptress 2nd" (3070), by "Duke of Cornwall" (820); g. d., "Gold Medal Temptress" (1672), by "Davy's Napoleon 3rd" (464).

SIR WILLIAM WILLIAMS, Bart., Heanton, Barnstaple, Devon: THIRD PRIZE, 5*l.*, for "Temptress 8th;" was calved May 14th, 1876; in-milk; calved April 26th, 1882; bred by Mrs. Langdon, Flitton Barton; sire, "Duke of Flitton 10th;" dam, "Temptress 5th," by "Duke of Flitton 5th;" g. d., "Temptress 2nd," by "Duke of Cornwall," gr. g. d., "Gold Medal Temptress," by "Davy's Napoleon."

ALFRED C. SKINNER, Pound Farm, Bishop's Lydeard, Taunton: the *Reserve Number* and *Highly Commended* for "Famous 2nd" (5289); was calved Oct. 17th, 1877; in-milk; calved Oct. 22nd, 1881, and in-calf; bred by Mr. W. Farthing, Stowey Court, Bridgwater; sire, "Master Willie" (1163); dam, "Famous" (4448), by "Son of Lord Quantock" (874); g. d., "Famous" (1965), by "Duke of Chester" (404).

Devon Cows or Heifers in-milk or in-calf, calved in the Year 1879.

ALFRED C. SKINNER, Pound Farm, Bishop's Lydeard, Taunton: FIRST PRIZE, 15*l.*, for "Myrtle 7th" (5544); was calved March 4th; in-milk; calved March 12th, 1882; bred by himself; sire, "Duke of Farrington" (1323); dam, "Myrtle 1st" (4765), by "Squire Winter" (1453); g. d., "Old Myrtle."

JOHN WALTER, M.P., Bearwood, Wokingham, Berks: SECOND PRIZE, 10*l.*, for "Lady Bearwood;" was calved Nov. 9th; in-calf; bred by Mr. W. Farthing, Stowey Court, Bridgwater; sire, "Lord Newsha 1. "Charlotte" (3254), by "Sir George" (925).

WILLIAM ROLLES FRYER, Lytchett Minster, Poole, Dorset: THIRD PRIZE, 5*l.*, for "Lavender" (5474); was calved Dec. 20th; in-calf; bred by himself; sire, "Flower's Duke" (1341); dam, "Dowager" (4406), by "Duke of Plymouth" (1080); g. d. "Doubleteats" (4405).

WILLIAM STENLAKE NORTHEY, Tinhay, Lifton, Devon: the *Reserve Number* and *Commended*, for "Temptress 16th;" was calved June 26th; calved Nov. 29th, 1881, and in-calf; bred by Mrs. Langdon, Flitton Barton, North Molton; sire, "Lord Bath" (1379); dam, "Temptress 2nd" (3070), by "Duke of Cornwall" (820); g. d., "Gold Medal Temptress" (1672), by "Davy's Napoleon" (464).

Devon Heifers calved in the Year 1880.

JOHN HOWES, Leighland, Washford, Taunton, Somerset: FIRST PRIZE, 15*l.*, for "Daisy 4th;" was calved April 30th; in-calf; bred by himself; sire, "Nelson" (1413); dam, "Daisy 1st" (4360); g. d., "Daisy."

JOHN WALTER, M.P., Bearwood, Wokingham: SECOND PRIZE, 10*l.*, for "Venus 3rd;" was calved Aug. 16th; bred by Mr. W. Farthing, Stowey Court, Bridgwater; sire, "Lord Stowey" (1601); dam, "Venus" (3993), by "Quartly" (1197); g. d., "Verbena" (3090), by "Viscount" (746); gr. g. d., "Verbena" (2421), by "Son of Duke of Somerset" (186).

WILLIAM ROLLES FRYER, Lytchett Minster, Poole, Dorset: THIRD PRIZE, 5*l.*, for "Phlox" (5577); was calved Feb. 14th; in-calf; bred by Viscount

Portman, Bryanston, Blandford, Dorset; sire, "Flower's Duke" (1341); dam, "Young Fancy" (5732), by "Triumph 3rd" (1475); g. d., "Fancy."

John Walter, M.P., Bearwood: the *Reserve Number* and *Highly Commended*, for "Famous 6th" (5287); was calved Sept. 20th; bred by himself; sire, "Royal Aston" (1437); dam, "Famous 3rd" (4451), by "Croydon Boy" (1309); g. d., "Famous 2nd" (3465), by "Eclipse" (835); gr. g. d., "Famous" (2685), by "Gold Seeker" (848).

Devon Heifers calved in the Year 1881.

Alfred C. Skinner, Pound Farm, Bishops Lydeard, Taunton: First Prize, 15*l.*, for "Lady Passmore 3rd;" was calved April 18th; bred by Mr. W. Farthing, Stowey Court, Bridgwater; sire, "Lord Stowey" (1601); dam, "Lady Passmore" (4657).

William Rolles Fryer, Lytchett Minster, Poole: Second Prize, 10*l.*, for "Rosemary" (5650); was calved Jan. 15th; bred by himself; sire, "The Squire" (1469); dam, "Dowager" (4406), by "Duke of Plymoth" (1080); g. d., "Doubleteats" (4405).

John Walter, M.P., Bearwood: Third Prize, 5*l.*, for "Princess Charlotte;" was calved Sept. 5th; bred by Mr. W. Farthing; sire, "Prettyface's Duke" (1627); dam, "Charlotte" (3254), by "Sir George" (925); g. d., "Cheerful" (3257), by "St. Audries."

Sir William Williams, Bart., Heanton, Barnstaple, Devon: the *Reserve Number* and *Highly Commended*, for "Fanciful;" was calved Nov. 4th; bred by himself; sire, "Actor;" dam, "Actress 15th," by "Jonquil;" g. d., "Actress 7th," by "Duke of Flitton 6th;" gr. g. d., "Actress 3rd," by "Duke of Flitton 2nd."

Sussex Bulls calved in either 1876, 1877, 1878, 1879, *or* 1880.

Edward and Alfred Stanford, Eatons, Ashurst, Steyning, Sussex: First Prize, 20*l.*, for "Goldsmith" (391), red; was calved in August, 1877; bred by the late Mr. G. Smith, Paddockhurst, Crawley, Sussex; sire, "Young Hartley" (444); dam, "Young Golding."

James S. Hodgson, Lythe Hill, Haslemere, Surrey: Second Prize, 10*l.*, for "Oxford" (304), red; was calved Sept. 15th, 1877; bred by Mr. A. Agate, Broomhall, Horsham; sire, "Berry" (259); dam, "Honesty 2nd" (1618), by "Alfred 2nd" (177); g. d., "Honesty" (1333), by "Grand Duke" (183); gr. g. d., "Honesty" (443), by "Unicorn" (15), and the *Reserve Number* and *Highly Commended*, for "Lord Oxford" (461), red, was calved December 18th, 1880; bred by himself; sire, "Oxford" (304); dam, "Pitcher 3rd" (2105), by "Berry" (259); g. d., "Pitcher 2nd" (1545), by "Grand Duke" (183); gr. g. d., "Pitcher" (1424).

Sussex Bulls calved in the Year 1881.

Edward and Alfred Stanford, Eatons, Ashurst, Steyning: First Prize, 15*l.*, for "Duke of Ashurst" (457), red; was calved January 9th; bred by themselves; sire, "Heasman" (392); dam, "Mary Fern 4th" (2263), by "Clayton" (319); g. d., "Mary Fern 2nd" (2085), by "Child Bull;" gr. g. d., "Mary Fern" (1189), by "Westminster" (138), and Second Prize, 10*l.*, for "Reading," red, March 31st; bred by themselves; sire, "Goldsmith;" dam, "Rosedew 5th" (2289) by "Clayton" (319); g. d., "Rosedew 1st" (2129), by Dorchester (325); gr. g. d., "Rosedew" (2128), by "Young Westminster" (159).

ALFRED AGATE, Broomhall, Horsham, the *Reserve Number*, for "Frankenstein 3rd," red; was calved August 18th; bred by himself; sire, "Frankenstein 2nd" (328); dam, "Lucy 2nd" (2065), by "Alfred 2nd" (177).

Sussex Cows or Heifers, in-milk or in-calf, calved previously to or in the Year 1879.

ALFRED AGATE, Broomhall, FIRST PRIZE, 15*l.*, for "Snowdrop" (1727), red; was calved in 1874; in-milk; calved March 13th, 1882; bred by Messrs. Heasman, of Angmering, Sussex; sire, "Prince Arthur;" dam, "Leicester;" g. d., "Plymouth" (1024), by "The Duke;" gr. g. d., "Gentle" (574).

CAPTAIN PHILIP GREEN, Bayham Abbey, Lamberhurst, Sussex: SECOND PRIZE, 10*l.*, for his red; was calved April 13th, 1877; calved August 7th, 1880, and in-calf; bred by Mr. T. B. Landsell, Bayham Abbey Farm; sire, "The Standen Bull;" dam, "Duchess."

JAMES S. HODGSON, Lythe Hill, Haslemere, Surrey: the *Reserve Number* and *Highly Commended* for "Laura 5th" (2412), red; was calved Oct. 18th, 1879; in-calf; bred by himself; sire, "Oxford" (304); dam, "Laura 3rd" (2055), by "Little Tom;" g. d., "Laura 1st" (2053), by "Nottingham 1st" (190); gr. g. d., "Young Gentle."

Sussex Heifers calved in the Year 1880.

ALFRED AGATE, Broomhall, Horsham: FIRST PRIZE, 15*l.*, for "Honesty 6th," red; was calved Oct. 2nd; in-calf; bred by himself; sire, "Robinson Crusoe 2nd" (361); dam, "Honesty 1st" (1617), by "Alfred 2nd" (177); g. d., "Honesty" (1333).

CAPTAIN PHILIP GREEN, Bayham Abbey: SECOND PRIZE, 10*l.*, for "Bramber," red; was calved May 23rd; in-calf; bred by himself; sire, "Horsham;" dam, "Brier" (2194).

EDWARD and ALFRED STANFORD, Eatons, Ashurst, Steyning, Sussex: the *Reserve Number* and *Highly Commended*, for "Dorset 8th" (2365), red; was calved March 11th; in-calf; bred by themselves; sire, "Goldsmith" (391); dam, "Dorset 2nd" (1993), by "Dorchester" (325); g. d., "Dorset" (1991), by "Young Westminster" (159).

Sussex Heifers calved in the Year 1881.

EDWARD and ALFRED STANFORD, Eatons: FIRST PRIZE, 15*l.*, for "Magdala 22nd" (2652), red; was calved Jan. 17th; bred by themselves; sire, "Goldsmith" (391); dam, "Magdala 9th" (2255), by "Dorchester" (325); g. d., "Magdala 3rd" (1185); gr. g. d. "Magdala 1st" (1183).

CAPTAIN PHILIP GREEN, Bayham Abbey, Lamberhurst: SECOND PRIZE, 10*l.*, for "Bertha," red, was calved April 30th; bred by himself.

ALFRED AGATE, Broomhall, Horsham: the *Reserve Number* and *Highly Commended* for "Young Gentle," red; was calved Jan. 12th; bred by himself; sire, "Young Hartley" (444); dam, "Young Gentle" (1737), by "Frankenstein" (181); g. d. "Gentle."

Longhorn Bulls calved in either 1876, 1877, 1878, 1879, *or* 1880.

SAMUEL FORREST, The Chase, Kenilworth, Warwickshire: FIRST PRIZE, 20*l.*, for "The Captain," red and white; was calved March 12th, 1877; bred

by the late Mr. J. Godfrey, Wigston Parva, Hinckley; sire, "The Blue Knight" (222); dam, "Fair," by "Sampson 1st" (192); g. d. "Curly Coat," by "Sparkenhoe" (206); gr. g. d. "Lady," by "Perfection" (161).

William J. Legh, M.P., Lyme Hall, Disley, Stockport, Cheshire: Second Prize, 10*l*., for "Brutus," brindle and white; was calved Aug. 12th, 1879; bred by himself; sire, "Darnley" (49); dam, "Buttercup 2nd," by "The Stranger" (228); g. d. "Buttercup," by "Bosworth Sparkenhoe" (10); gr. g. d. "Rollright."

Richard Hall, Thulston Grove, Derby: the *Reserve Number* to "Victor Chief," brindle and white; was calved March 8th, 1876; bred by Lord Bagot, Blithfield, Rugeley, Staffs.; sire, "Prince Victor;" dam, "Dairymaid."

Longhorn Bulls calved in the Year 1881.

Richard Hall, Thulston Grove: First Prize, 15*l*., for "Proctor," brindle and white; was calved July 4th; bred by himself; sire, "The Monk;" dam, "Pride of the Park," by "Brindled Boy;" g. d. "Beauty;" gr. g. d. "Damsel."

John German, Huntingdon House, Ashby-de-la-Zouch: Second Prize, 10*l*., for "Earl of Huntingdon," brindle and white; was calved July 5th; bred by himself; sire, "The Abbot of Calke" (220); dam, "Lady Huntingdon," by "Royal Duke of Upton" (187); g. d., "Upton Hero" (243).

Longhorn Cows or Heifers, in-milk or in-calf, calved previously to or in the Year 1879.

Richard Hall, Thulston Grove, Derby; First Prize, 15*l*., for "Celia," red and white; was calved April 22nd, 1877; in-milk; calved Oct. 8th, 1881, and in-calf; bred by himself; sire, "Prince Royal;" dam, "Calke," by "Earl of Warwick;" g. d., "Old Brindled Beauty," by "Old Sparkenhoe;" gr. g. d., "Fillpail," by "Shakespeare."

The Duke of Buckingham and Chandos, Stowe, Buckingham: Second Prize, 10*l*., for "Violet," brindle and white; was calved July 31st, 1879; in-calf; bred by himself; sire, "Conqueror 3rd;" dam, "Verbena," by "Conqueror;" g. d., "Veronica," by "Boycott;" gr. g. d., "Vesper."

Richard Hall, Thulston Grove: the *Reserve Number* and *Highly Commended* for "Fairy 5th," brindle and white; was calved in 1877; in-milk; calved Feb. 7th, 1882; bred by the late Mr. J. Godfrey, Wigston Parva, Hinckley; sire, "Tiger;" dam, "Fairer," by "Shakespeare;" g. d., "Fair," by "Sampson;" gr. g. d., "Curly Coat," by "Old Sparkenhoe."

Longhorn Heifers, calved in the Year 1880.

Richard Hall, Thulston Grove: First Prize, 15*l*., for "Brindled Nell," brindle and white; was calved July 8th; bred by himself; sire, "Baron Hardendale;" dam, "Brindled Nancy," by "Twycross;" g. d., "Myrtle;" gr. g. d., "Bramcote Rose."

The Duke of Buckingham and Chandos, Stowe, Buckingham: Second Prize, 10*l*., for "Winifred 3rd," red and white; was calved July 9th; bred by himself; sire, "Earl of Temple;" dam, "Winifred," by "Young Conqueror;" g. d., "Wildfire," by "Boycott;" gr. g. d., "Woodbine," by "Tamworth."

Jersey Bulls calved in either 1876, 1877, 1878, 1879, *or* 1880.

William Arkwright, Sutton Scarsdale, Chesterfield, Derbyshire: First Prize, 20*l*., for "Progress 2nd," dark grey; was calved Feb. 15th, 1880; bred by Mr. P. Mourant, St. Saviour's, Jersey; sire, "Progress" (286 J.H.B.); dam, "Violet 2nd" (149 J.H.B.), by "Sans Peur" (201 J.H.B.); g. d., "Violet" (506 J.H.B.).

Mrs. Malcolm, Beechwood, Lyndhurst, Hants: Second Prize, 10*l*., for "Lord Chichester," grey fawn; was calved Oct. 20th, 1880; bred by Mr. G. Simpson, Wray Park; sire, "Milkboy" (561); dam, "Chichester," by "Osborne" (614); g. d, "Polly."

George Simpson, Wray Park, Reigate, Surrey: Third Prize, 5*l*., for "Farmer's Joy," grey; was calved Feb. 28th, 1880; bred by Mr. J. Arthur, St. Mary's Jersey; sire, "Farmer's Glory" (319 E.H.B.); dam, "Victory" (1999 J.H.B.).

William Alexander, Grasfort Farm, Gouray, Jersey: the *Reserve Number* and *Highly Commended* for "Farmer's Hope" (344 J.H.B.), dark grey; was calved March 7th, 1880; bred by Mr. J. Le Brocq, St. Clement's, Jersey; sire, "Farmer's Glory" (274 J.H.B.); dam, "Verbena" (1628 J.H.B.).

Jersey Bulls calved in the Year 1881.

James Richard Corbett, More Place, Betchworth, Surrey: First Prize, 15*l*., for "Baron Betchworth," silver grey; was calved July 8th; bred by himself; sire, "Prince Bolivot;" dam, "Baroness," by "Duke of Wellington" (293).

Henry James Cornish, Thornford, Sherborne, Dorset: Second Prize, 10*l*., for "Grey of the West 2nd," grey; was calved Feb. 5th; bred by Mr. J. Arthur, St. Mary's, Jersey; sire, "Farmer's Glory" (274 J.H.B.); dam, "Lily Grey" (2000 J.H.B.).

Lieut.-Colonel Portal, Ashe Park, Micheldever, Hants: Third Prize, 5*l*., for "Sultan," whole dark fawn; was calved April 23rd; bred by Mr. E. Denize, St. Lawrence, Jersey; sire, "Bright" (308 J.H.B.); dam, "Sultana" 2046 J.H.B.).

William Alexander, Grasfort Farm, Gouray, Jersey: the *Reserve Number Highly Commended* for "Berkeley," silver grey; was calved in June; bred by himself; sire, "Noble."

Jersey Cows or Heifers, in-milk or in-calf, calved previously to or in the Year 1879.

William Arkwright, Sutton Scarsdale, Chesterfield: First Prize, 20*l*., for "Kilburn Maid," fawn; was calved in June, 1879 (calved July 22nd, 1881), due to calve before July 10th; bred by Mr. J. P. Maret, Maison Haute, St. Saviour's, Jersey; sire, "Willie" (245 J.H.B.); dam, "Zenobia" (86 J.H.B.), by "Grey King" (40 J.H.B.); g. d. "Sultana" (7 J.H.B.), by "Sultan" (58 J.H.B.); gr. g. d., "Longueville Queen" (272 J.H.B.).

George Simpson, Wray Park, Reigate: Second Prize, 10*l*., for "Island Belle," dark grey fawn; was calved April 14th, 1878; in-calf, due to calve before July 10th; bred by Mr. Laffolley, Jersey. And Third Prize, 5*l*., for "Pandora 3rd," light fawn; was calved Oct. 22nd, 1879; in-milk; calved Jan. 20th, 1882; bred by himself; sire, "Farmer's Glory;" dam, "Pandora 2nd," by "Milord" (566 E.H.B.); g. d., "Pandora" (1645 J.H.B.).

Mrs. Malcolm, Beechwood, Lyndhurst, Hants: the *Reserve Number* and *Highly Commended* for "Temptation 2nd," dark grey; was calved June 28th, 1877 (calved March 23rd, 1881); due to calve in May, 1882; bred by Mr. J. Le Brun, St. Ouen's, Jersey; sire, "Apollo" (108 J.H.B.); dam, "Temptation" (102 J.H.B.), by "Prince" (155 J.H.B.); g. d., "Touch-me-not" (1144).

Jersey Heifers calved in the Year 1880.

Henry James Cornish, Thornford, Sherborne, Dorset: First Prize, 15*l.*, for "Alice," dark grey; was calved in March; bred by Mr. F. Le Brocq, St. Peter's, Jersey.

Philip John Brideaux, Chestnut Farm, St. Heliers, Jersey: Second Prize, 10*l.*, for "Fair," cream fawn; was calved Aug. 22nd; in-calf; bred by Mr. Mourant, St. Saviour's, Jersey; sire, "Platon" (310 J.H.B.); dam, "Favourite" (358 J.H.B.).

John Cardus, Town Hill, West End, Southampton: Third Prize, 5*l.*, for "Gloriosa," grey fawn; was calved May 29th; in-calf; bred by Mr. C. B. Dixon, Shirley Warren; sire, "Farmer's Glory" (319); dam, "Fancy Fair 2nd," by "Vertumnus" (908); g. d., "Fancy Fair," by "Loyal" (514).

James Richard Corbett, More Place, Betchworth, Surrey: the *Reserve Number* and *Highly Commended* for "Stella 2nd," grey; was calved Dec. 15th; bred by himself; sire, "Baron;" dam, "Stella."

Jersey Heifers calved in the Year 1881.

Eugene John Arnold, Bronté Lodge, Jersey: First Prize, 10*l.*, for "Mona 2nd," whole silver fawn; was calved Feb. 24th; bred by Mr. Hacquvil, Letac, St. Ouen's, Jersey; sire, "Lord Beaconsfield;" dam, "Mona" (2486).

George Simpson, Wray Park, Reigate: Second Prize, 5*l.*, for "Patricia 2nd," grey fawn; was calved May 17th; bred by himself; sire, "Prince Imperial;" dam, "Patricia," by "Romeo" (760 E.H.B.); g. d., "Portia," by "Welcome 2nd" (937 E.H.B.); gr. g. d., "Fleurie" (859 J.H.B.).

John Cardus, Town Hill, West End, Southampton: the *Reserve Number* and *Highly Commended* for "Inez," silver grey; was calved March 16th; bred by himself; sire, "Dairy King" (211); dam, "Elite," by "Grey Prince;" g. d., "Jeannette."

Guernsey Bulls calved in either 1876, 1877, 1878, 1879, *or* 1880.

Lieut. Colonel W. Hood Walrond, M.P., Newcourt, Topsham, Devon: First Prize, 10*l.*, for "Romulus," yellow and white; was calved July 15th, 1879; bred by himself; sire, "The Count;" dam, "Buttercup."

James James, Les Vauxbelets, Guernsey: Second Prize, 5*l.*, for "Squire of Les Vauxbelets," red and white; was calved Nov. 2nd, 1877; bred by himself; sire, "Royal Duke;" dam, "Valentine 1st," by "Forester," g. d., "Rosy:" and the *Reserve Number* and *Highly Commended* for "Sir Lancelot of Les Vauxbelets," red and white; was calved Aug. 8th, 1880; bred by himself; sire, "Squire of Les Vauxbelets;" dam, "Lady Emily Foley 2nd;" g. d., "Lady Emily Foley 1st."

Guernsey Cows or Heifers, in-milk or in-calf, calved previously to or in the Year 1879.

JAMES JAMES, Les Vauxbelets: FIRST PRIZE, 10*l.*, for "Lady Emily Foley 2nd," orange fawn; was calved June 1st, 1877; calved July 9th, 1881; and due to calve June 13th, 1882; bred by Mr. W. M. Jones, La Marcherie, St. Martin's, Guernsey; dam, "Lady Emily Foley 1st": and SECOND PRIZE, 5*l.*, for "Valentine 3rd," lemon and white; was calved Nov. 3rd, 1874; in-milk; calved May 9th, 1882; bred by himself; sire, "Lord of Les Vauxbelets;" dam, "Valentine 1st," by "Forrester;" g. d., "Rosy."

HERBERT LANCELYN GREEN, Ville Amphrey, St. Martin's, Guernsey: the *Reserve Number* and *Highly Commended* for "Lady Jane No. 2," fawn and white; was calved May 1st, 1875; calved in May, 1881; in-calf; bred by Mr. Rendle, Catel Farm, Guernsey; dam, "Lady Jane No. 1."

Guernsey Heifers calved in the Year 1880.

HERBERT LANCELYN GREEN, of Ville Amphrey: FIRST PRIZE, 10*l.*, for "Miranda," fawn and white; was calved May 12th; in-calf; bred by Mrs. Martel, Preel Catil, Guernsey.

AUGUSTIN ROBINSON, West Lavant House, Chichester the *Reserve Number* to "Rosette," red; was calved July 6th; in-calf; bred by himself; sire, "Champion;" dam, "Rose 2nd," by "Prince 2nd;" g. d., "Rose."

Norfolk and Suffolk Polled Bulls calved either in 1876, 1877, 1878, 1879 *or* 1880.

JOHN HAMMOND, of Bale, Dereham, Norfolk: FIRST PRIZE, 10*l.*, for "Davyson 7th," red; was calved Dec. 1st, 1878; bred by himself; sire, "Davyson 5th;" dam, "Davy 10th," by "Sir Nicholas 2nd;" g. d., "Davy 3rd," by "Sir Nicholas;" gr. g. d., "Rose of Hope," by "Rufus."

JEREMIAH J. COLMAN, M.P., Carrow House, Norwich: SECOND PRIZE, 5*l.*, for "King Charles" (329), red; was calved June 21st, 1876; bred by the late Mr. J. F. Palmer, Wilby, Norfolk; sire, "Davyson 3rd" (48); dam, "Young Spot," by "Wilby Chapman" (228); g. d., "Spot," by "Wonder" (231); gr. g. d., "Rose."

ROBERT H. MASON, Necton Hall, Swaffham, Norfolk: the *Reserve Number* and *Highly Commended* for "Slasher," red; was calved Nov. 3rd, 1877; bred by Mr. R. E. Lofft, Troston Hall, Bury St. Edmunds; sire, "Hector" (319); dam, "Waxwork 2nd," by "King of Carlford" (100); g. d., "Minnie 3rd," by "Hammond" (81); gr. g. d., "Minnie N. 1," by "Necton Prize" (120).

Norfolk and Suffolk Polled Bulls calved in the Year 1881.

ALFRED TAYLOR, Starston, Harleston, Norfolk: FIRST PRIZE, 10*l.*, for "Passion," red; was calved Jan. 2nd; bred by himself; sire, "King Charles" (329); dam, "Sly" (1192), by "Sir Edward 1st" (197); g. d., "Strawberry 2nd R 2," by "Richard II." (173); gr. g. d., "Tiny R 2," by "Laxfield Sire" (101).

ROBERT EMLYN LOFFT, Troston Hall, Bury St. Edmunds: SECOND PRIZE, 5*l.*, for "Cortes," red; was calved Aug. 8th; bred by himself; sire, "Stout" (581); dam, "Handsome 8th," by "Bright" (267); g. d., "Handsome 5th," by "Troston Hero" (221).

JEREMIAH J. COLMAN, M.P., Carrow House, Norwich: the *Reserve Number* and *Highly Commended* for "King Charming," red; was calved Sept. 22nd; bred by himself; sire, "Rufus" (188); dam, "Rosebud 2nd," by "Rufus" (188); g. d., "Rosebud," by "Norfolk Duke" (127); gr. g. d., "Cherry 2nd," by "Tenant Farmer" (213).

Norfolk and Suffolk Polled Cows or Heifers, in-milk or in-calf, calved previously to or in the Year 1879.

JEREMIAH J. COLMAN, M.P., Carrow House: FIRST PRIZE, 10*l.*, for "Cherry Leaf," red; was calved Oct. 17th, 1878; in-milk; calved Dec. 3rd, 1881, and in-calf; bred by himself; sire, "Beau" (259); dam, "Cherry 5th," by "Norfolk Duke" (127); g. d., "Cherry 2nd," by "Norfolk Duke" (127); gr. g. d., "Cherry."

ALFRED TAYLOR, Starston, Harleston, Norfolk: SECOND PRIZE, 5*l.*, for "Flirt" (894), red; was calved July 26th, 1876; in-milk; calved Feb. 18th, 1882; bred by himself; sire, "Easton Duke" (61); dam, "Sly" (1192), by "Sir Edward 1st" (197); g. d., "Strawberry 2nd R 2," by "Richard 2nd" (173); gr. g. d., "Tiny R 2," by "Laxfield Sire" (101).

Norfolk and Suffolk Polled Heifers calved in the Year 1880.

THE DUKE OF HAMILTON AND BRANDON, K.T., Easton Park, Wickham Market, Suffolk: FIRST PRIZE, 10., for "Kattie's Sister," red; was calved July 28th; in-calf; bred by himself; sire, "Handsome Prince;" dam, "Kattie," by "Benedict;" g. d., "Ringlet 2nd," by "Tenant Farmer;" gr. g. d., "Ringlet," by "Hero of Newcastle."

WILLIAM AMHURST TYSSEN-AMHERST, M.P., Didlington Hall, Brandon, Norfolk: SECOND PRIZE, 5*l.*, for "Poppy," red; was calved July 29th; in-calf; bred by Mr. R. E. Lofft, Troston Hall, Bury St. Edmund's; sire, "Stout" (581); dam, "Poppet 2nd" (U 43), by "Cherry Duke" (32); g. d., "Poppet" (U 43), by "Sampson" (191).

ROBERT E. LOFFT, Troston Hall, Bury St. Edmund's: the *Reserve Number* and *Highly Commended* for "Minnie 7th," red; was calved October 20th; bred by himself; sire, "Ross" (562); dam, "Minnie 5th," by "Bright" (267); g. d., "Minnie 3rd," by "Hammond" (81).

Norfolk and Suffolk Polled Heifers calved in the Year 1881.

JOHN HAMMOND, Bale, Dereham, Norfolk: FIRST PRIZE, 10*l.*, for "Davy 37th," red; was calved in June; bred by himself; sire, "Davyson 7th;" dam, "Davy 21st," by "Davyson 5th;" g. d., "Davy 7th," by "Young Duke;" gr. g. d., "Davy 2nd," by "Sir Nicholas."

ROBERT E. LOFFT, Troston Hall, Bury St. Edmund's: SECOND PRIZE, 5*l.*, for "Bridesmaid 9th," red; was calved July 21st; bred by himself; sire, "Stout" (581); dam, "Bridesmaid 3rd," by "Cherry Duke" (32); g. d., "Bridesmaid 1st."

ALFRED TAYLOR, Starston, Harleston, Norfolk: the *Reserve Number* and *Highly Commended* for "Fame" (1505), red; was calved Feb. 3rd; bred by himself; sire, "King Charles" (329); dam, "Flirt" (894), by "Easton Duke" (61); g. d., "Sly" (1192), by "Sir Edward 1st" (197); gr. g. d., "Strawberry 2nd" (R 2), by "Richard 2nd" (173).

Dairy Cows in-milk, calved previously to or in the Year 1878.†

THE MARCHIONESS OF DOWNSHIRE, Easthampstead Park, Wokingham, Berks: FIRST PRIZE, 25*l.*, for "Strawberry" (Crossbreed), roan; was calved in 1877; calved April 28th, 1882; bred by herself.

JOSEPH PHILLIPS, Park Meadow Farm, Peterborough: SECOND PRIZE, 15*l.*, for "Red Cherry" (Shorthorn), red; was calved Nov. 24th, 1875; calved April 26th, 1882; bred by himself.

GEORGE FERME, Leigham Lodge Farm, Roupell Park, Streatham Hill, Surrey: THIRD PRIZE, 10*l.*, for his (Ayrshire), brown and white; age unknown; bred by himself.

GEORGE F. KING, Elm Farm, Chewton Keynsham, Bristol: the *Reserve Number* and *Highly Commended* for "Fillpail 2nd" (Shorthorn) red and white; was calved March 15th, 1878; calved April 1st, 1882; bred by himself; sire, "Utility" (35841); dam, "Fillpail," by "Starlight."

Dairy Heifers in-milk calved in the Year 1879.*

THE MARCHIONESS OF DOWNSHIRE, of Easthampstead Park, Wokingham, Berks: FIRST PRIZE, 20*l.*, for "Tulip" (Crossbreed), brown; bred by herself.

CAPTAIN R. H. VERSCHOYLE, Springfield, Ross, Herefordshire: SECOND PRIZE, 10*l.*, for "Pixie" (Crossbreed), brown; was calved Nov. 28th; in-calf; bred by himself.

GEORGE FERME, Leigham Lodge Farm, Roupell Park, Streatham Hill, Surrey: THIRD PRIZE, 5*l.*, for his (Ayrshire), brown and white; bred by himself: and the *Reserve Number* and *Highly Commended* for his (Ayrshire), brown and white; breeder unknown.

SHEEP.

Leicester Shearling Rams.

JOHN and DAVID LINTON, Low Street, Bedale, Yorkshire: FIRST PRIZE, 15*l.*; bred by themselves.

TEASDALE HILTON HUTCHINSON, Manor House, Catterick, Yorkshire: SECOND PRIZE, 10*l.*; bred by himself; sire, "Royal Carlisle."

GEORGE TURNER, jun., Thorplands, Northampton: the *Reserve Number*; bred by himself.

Leicester Two-Shear Rams.

TEASDALE HILTON HUTCHINSON: FIRST PRIZE, 15*l.*, for "Royal Derby;" bred by himself; sire, "Royal Liverpool."

JOHN and DAVID LINTON: SECOND PRIZE, 10*l.*, for "Royal Liverpool;" bred by themselves.

TEASDALE HILTON HUTCHINSON: the *Reserve Number* and *Highly Commended* for "Yorkshireman," bred by himself; sire, "Doncaster."

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† Prizes given by Sir R. Loyd Lindsay, Bart., V.C., M.P., through the Reading Local Committee.

Leicester Shearling Ewes—Pens of Five.

JOHN and DAVID LINTON: FIRST PRIZE, 15*l.*; bred by themselves.

ERNEST FRANCIS JORDAN, Eastburn, Driffield, Yorkshire: SECOND PRIZE, 10*l.*; bred by himself.

WILLIAM BROWN, High Gate House, Holme on Spalding Moor: the *Reserve Number* and *Highly Commended*; bred by himself.

Cotswold Shearling Rams.

ROBERT JACOBS, Signet Hill, Burford, Oxon: FIRST PRIZE, 15*l.*; bred by himself.

T. and S. G. GILLETT, Kilkenny Farm, Faringdon, Oxon: SECOND PRIZE, 10*l.*; bred by themselves.

THOMAS BROWN, Marham Hall, Downham Market, Norfolk: the *Reserve Number* and *Highly Commended*; bred by himself.

Cotswold Two-Shear Rams.

RUSSELL SWANWICK, Royal Agricultural College Farm, Cirencester: FIRST PRIZE, 15*l.*; bred by himself.

T. and S. G. GILLETT, Kilkenny Farm, Faringdon, Oxon: SECOND PRIZE, 10*l.*; bred by themselves.

RUSSELL SWANWICK: the *Reserve Number* and *Highly Commended*; bred by himself.

Cotswold Shearling Ewes—Pens of Five.

ROBERT JACOBS, Signett Hill, Burford, Oxon: FIRST PRIZE, 15*l.*; and SECOND PRIZE, 10*l.*; bred by himself.

HENRY AKERS, Black Bourton, Faringdon, Berks: the *Reserve Number* and *Highly Commended*; bred by himself.

Lincoln Shearling Rams.

ARTHUR GARFIT, Scothern, Lincoln: FIRST PRIZE, 15*l.*; bred by himself.

HENRY SMITH, The Grove, Cropwell Butler, Nottingham: SECOND PRIZE, 10*l.*; bred by himself.

WILLIAM and THOMAS CARTWRIGHT, Blankney Fen, Lincoln: the *Reserve Number* and *Highly Commended*; bred by themselves.

Lincoln Two-Shear Rams.

HENRY SMITH, The Grove, Cropwell Butler: FIRST PRIZE, 15*l.*; and SECOND PRIZE, 10*l.*; both bred by himself.

JOHN PEARS, Mere, Lincoln: the *Reserve Number* and *Highly Commended*; bred by himself.

Lincoln Shearling Ewes—Pens of Five.

JOHN PEARS, Mere, Lincoln: FIRST PRIZE, 15*l.*; bred by himself.

WILLIAM and THOMAS CARTWRIGHT, Blankney Fen, Lincoln: SECOND PRIZE, 10*l.*; bred by themselves.

Other Long-wools—Shearling Rams.

Sir J. H. Heathcote-Amory, Bart., M.P., Knightshays Court, Tiverton: First Prize, 10*l.*, for his Devon Long-wool; bred by himself.

John S. S. Goodwin, Hazlewood, Hadlow, Tonbridge, Kent: Second Prize, 5*l.*, for his Romney Marsh; bred by himself.

Sir J. H. Heathcote-Amory, Bart., M.P.: the *Reserve Number* and *Commended* for his Devon Long-wool; bred by himself.

Other Long-wools—Two-Shear Rams.

Sir J. H. Heathcote-Amory, Bart., M.P.: First Prize, 10*l.*, for "Magnum Bonum," Devon Long-wool; bred by himself.

John S. S. Goodwin, Hazlewood, Hadlow, Tonbridge: Second Prize, 5*l.*, for his Romney Marsh; bred by himself.

Sir J. H. Heathcote-Amory, Bart., M.P.: the *Reserve Number* and *Commended* for "Comet," Devon Long-wool; bred by himself.

Other Long-wools—Shearling Ewes—Pens of Five.

Joseph Norris Franklin, Huxham, Exeter: First Prize, 10*l.*, for his Devon Long-wools; bred by himself.

Sir J. H. Heathcote-Amory, Bart., M.P.: Second Prize, 5*l.*, for his Devon Long-wools; bred by himself.

Lord Hothfield, Hothfield Place, Ashford, Kent: the *Reserve Number* and *Highly Commended* for his Romney Marsh; bred by himself.

Oxfordshire Down Shearling Rams.

John Treadwell, Upper Winchendon, Aylesbury, Bucks: First Prize, 15*l.*, for "Earl of Oxford;" sire, Mr. Howard's No. 25a, by "Earl of Beaconsfield:" Second Prize, 10*l.*, for "Prince Albert;" sire, "Prince of Wales:" and the *Reserve Number* and *Highly Commended* for "Marquis of Oxford;" sire, "Duke of Oxford;" all bred by himself.

Oxfordshire Down Two-Shear Rams.

John Treadwell: First Prize, 15*l.*, for "Young Freeland;" bred by himself; sire, "Blenheim Champion;" dam by "Freeland."

Charles Hobbs, Maisey Hampton, Fairford, Gloucestershire: Second Prize, 10*l.*; bred by himself.

George Street, Maulden, Ampthill, Beds: the *Reserve Number* to "Lord Derby;" bred by himself; sire, "Freeland 4th."

Oxfordshire Down Shearling Ewes—Pens of Five.

Charles Hunt, Fawler, Charlbury, Oxon: First Prize, 15*l.*; bred by himself.

Albert Brassey, Heythrop Park, Chipping Norton, Oxon.: Second Prize, 10*l.*; bred by himself.

Frederick Street, Somersham Park, St. Ives, Hunts: Third Prize, 5*l.*: bred by himself.

Albert Brassey: the *Reserve Number* and *Highly Commended*; bred by himself.

*Oxfordshire Down Ram Lambs—Pens of Five.**

A. F. Milton Druce, Fyfield, Abingdon, Berks: First Prize, 15*l.*; bred by himself.

Albert Brassey, Heythrop Park: Second Prize, 10*l.*, and Third Prize, 5*l.*; bred by himself.

Charles Hunt, Fawler, Charlbury: the *Reserve Number* and *Highly Commended;* bred by himself.

*Oxfordshire Down Ewe Lambs—Pens of Five.**

A. F. Milton Druce, Fyfield, Abingdon: First Prize, 15*l.*; bred by himself.

Charles Hunt, Fawler, Charlbury: Second Prize, 10*l.*; bred by himself.

Albert Brassey, Heythrop Park: Third Prize, 5*l.*, and the *Reserve Number* and *Highly Commended;* bred by himself.

Shropshire Shearling Rams.

Thomas James Mansell, Dudmaston Lodge, Bridgnorth, Salop: First Prize, 15*l.*; bred by himself.

Matthew Williams, Bishton Hall, Shifnal: Second Prize, 10*l.*; bred by himself.

Joseph Beach, The Hattons, Brewood, Staffs.: Third Prize, 5*l.*; bred by himself.

Matthew Williams: the *Reserve Number* and *Highly Commended.*

Shropshire Two Shear Rams.

Thomas Stephen Minton, Montford, Montford Bridge, Salop: First Prize, 15*l.*: bred by himself.

Thomas James Mansell, Dudmaston Lodge, Bridgnorth: Second Prize, 10*l.*: bred by himself: sire, "Milton;" dam by "Truestock."

J. Bowen Jones, Ensdon House, Montford Bridge, Salop: Third Prize, 5*l.*; bred by himself; sire, "Royal Reserve."

James Lenox Naper, Loughcrewe, Oldcastle, Ireland: the *Reserve Number* and *Highly Commended* for "Prejudice;" bred by himself; sire, "Pride of Bishton."

Shropshire Shearling Ewes—Pens of Five.

John Edward Farmer, Felton, Ludlow, Salop: First Prize, 15*l.*; bred by himself.

Joseph Beach, The Hattons, Brewood, Staffs.: Second Prize, 10*l.*: bred by himself.

Thomas Stephen Minton, Montford: Third Prize, 5*l.*: bred by himself.

Joseph Pulley, M.P., Lower Heaton, Hereford: the *Reserve Number* and *Highly Commended;* bred by himself; sire, "Young Sultan."

Southdown Shearling Rams.

Lord Walsingham, Merton Hall, Thetford, Norfolk: First Prize, 15*l.*; bred by himself.

H.R.H. The Prince of Wales, K.G., Sandringham, Norfolk: Second Prize, 10*l.*; bred by his Royal Highness.

George Carew Carew-Gibson, Sandgate, Pulborough, Sussex: Third Prize, 5*l.*; bred by himself; sire, "Leeds."

Jeremiah J. Colman, M.P., Carrow House, Norwich: the *Reserve Number* and *Highly Commended*; bred by himself.

Southdown Two-Shear Rams.

Lord Walsingham, Merton Hall, Thetford: First Prize, 15*l.*; bred by himself.

Jeremiah J. Colman, M.P., Carrow House, Norwich: Second Prize, 10*l.*; bred by himself.

William Rigden, Ashcroft, Kingston-by-Sea, Brighton: the *Reserve Number* and *Highly Commended*; bred by himself.

Southdown Shearling Ewes—Pens of Five.

Jeremiah J. Colman, M.P., Carrow House; First Prize, 15*l.*: bred by himself.

Lord Walsingham, Merton Hall, Thetford, Norfolk: Second Prize, 10*l.*; bred by himself.

H.R.H. The Prince of Wales, K.G., Sandringham, Norfolk: Third Prize, 5*l.*; bred by His Royal Highness.

The Duke of Richmond and Gordon, K.G., Goodwood, Chichester, Sussex; the *Reserve Number* and *Highly Commended*; bred by himself.

Hampshire Shearling Rams.

Alfred Morrison, Fonthill House, Tisbury, Wilts: First Prize, 15*l.*; bred by himself.

Henry Lambert, Babraham, Cambridge: Second Prize, 10*l.*; bred by himself.

Alfred Morrison, Fonthill House: the *Reserve Number* and *Highly Commended*; bred by himself.

Hampshire Two-Shear Rams.

Frank R. Moore, Littlecott, Pewsey, Wilts: First Prize, 15*l.*; bred by himself.

James Read, Homington, Salisbury, Wilts: Second Prize, 10*l.*; bred by himself.

Henry Lambert, Babraham, Cambridge: the *Reserve Number*; bred by himself.

Hampshire Shearling Ewes—Pens of Five.

William Parsons, West Stratton, Micheldever, Hants: First Prize, 15*l.*; bred by himself.

George Palmer, M.P., The Acacias, Reading: Second Prize, 10*l.*; bred by himself.

Sir John Kelk, Bart., Tedworth House, Marlborough: the *Reserve Number* and *Highly Commended*; bred by himself.

*Hampshire Ram Lambs—Pens of Five.**

WILLIAM PARSONS, West Stratton: FIRST PRIZE, 15*l.*; bred by himself.

JOHN BURTON, Hackwood Farm, Basingstoke: SECOND PRIZE, 10*l.*; bred by himself.

WILLIAM E. PAIN, East Stratton, Micheldever Station: THIRD PRIZE, 5*l.*; bred by himself.

ALFRED MORRISON, Fonthill House, Tisbury, Wilts: the *Reserve Number* and *Highly Commended;* bred by himself.

*Hampshire Ewe Lambs—Pens of Five.**

WILLIAM PARSONS, West Stratton, FIRST PRIZE, 15*l.*; bred by himself.

JOHN BURTON, East Stratton: SECOND PRIZE, 10*l.*; bred by himself.

JAMES READ, Hemington, Salisbury: THIRD PRIZE, 5*l.*: bred by himself.

J. A. and T. PALMER, Wallop, Stockbridge, Hants: the *Reserve Number* and *Highly Commended.*

Other Short-woolled Shearling Ewes—Pens of Five.

LORD POLTIMORE, Poltimore Park, Exeter: FIRST PRIZE, 10*l.* and SECOND PRIZE, 5*l.*; bred by himself.

PIGS.

Large White Breed—Boars farrowed in the Year 1881.

THE EARL OF ELLESMERE, Worsley Hall, Manchester: FIRST PRIZE, 10*l.*, for "Brutus;" was farrowed April 1st; bred by himself; sire, "Joseph;" dam by "Yorkshireman"; and SECOND PRIZE, 5*l.*, for "Gladiator;" was farrowed April 1st; bred by himself; sire, "Joseph;" dam by "Madman."

JAMES and FREDERICK HOWARD, Britannia Farms, Bedford: The *Reserve Number* and *Commended* for "Victor 4th;" was farrowed March 7th; bred by themselves; sire, "Victor 3rd;" dam, "Shortville," by "Champion."

Large White Breed—Boars farrowed in the Year 1879 *or* 1880.

THE EARL OF ELLESMERE, Worsley Hall: FIRST PRIZE, 10*l.*, for "Jumbo;" was farrowed August 17th, 1880; bred by himself; sire, "Joseph;" dam by "Samson 2nd;" and SECOND PRIZE, 5*l.*, for "Tiger 4th;" was farrowed July 27th, 1879; bred by himself; sire, "Tiger 2nd;" dam by "Peter the Great."

CHARLES ELMHIRST DUCKERING, Northorpe, Kirton-Lindsey, Lincolnshire: the *Reserve Number;* was farrowed Aug. 1st, 1879; bred by himself.

Large White Breed—Breeding Sow Pigs, of the same Litter, farrowed in the Year 1882.*—Pens of Three.*

THE EARL OF ELLESMERE, Worsley Hall: FIRST PRIZE, 10*l.*: were farrowed Jan. 6th; bred by himself; sire, "Tiger 3rd;" dam, "Duchess;" and

SECOND PRIZE, 5*l.*; were farrowed Jan. 13th; bred by himself; sire, "Tiger 3rd;" dam, "Duchess 2nd."

JOHN and JOSEPH NUTTALL, 13, Longfield, Haywood, Lancashire: the *Reserve Number*; were farrowed Jan. 14th; bred by themselves; sire, "Bill;" dam, "Ripstone," by "Samson."

Large White Breed—Breeding Sows, farrowed previously to or in the Year 1881.

THE EARL OF ELLESMERE, Worsley Hall: FIRST PRIZE, 10*l.*, for "Queen;" was farrowed July 1st, 1880: bred by himself; sire, "Tiger 2nd;" dam by "King Duncan."

JAMES and FREDERICK HOWARD, Britannia Farms, Bedford: SECOND PRIZE, 5*l.*, for "Clapham Beauty;" was farrowed Jan. 28th, 1878; bred by themselves; sire, "Major."

CHARLES DAVID PHILLIPS, Gaer Fach, Newport, Monmouthshire: the *Reserve Number* to "Giantess 2nd;" was farrowed Jan. 18, 1880; in-pig; bred by Mr. Robert Tommas, Birmingham; sire, "Billy;" dam, "Giantess 1st."

Middle White Breed—Boars farrowed in the Year 1881.

MAJOR H. PLATT, Gorddinog, Bangor, Carnarvonshire: FIRST PRIZE, 10*l.*, for "Excel;" was farrowed June 7th; bred by Mr. John Nuttall, Heywood, Lancashire; sire, "Gladstone."

THE EARL OF ELLESMERE, Worsley Hall, Manchester: SECOND PRIZE, 5*l.*, for "Ranger;" was farrowed June 9th; bred by himself; sire, "Peter;" dam by "King of the Peacocks."

JAMES and FREDERICK HOWARD, Britannia Farms, Bedford: the *Reserve Number*; was farrowed June 26th; bred by themselves; sire, "Hector;" dam, "Gloucester Beauty," by "Lord Liverpool."

Middle White Breed—Boars farrowed in the Year 1879 *or* 1880.

THE EARL OF ELLESMERE, Worsley Hall: FIRST PRIZE, 10*l.*, for "Prince;" was farrowed Aug. 7th, 1880; bred by himself; sire, "Peter;" dam, "Lady Howard."

WILSON CROSBY and Co., Apperley Bridge, Leeds: SECOND PRIZE, 5*l.*, for "Sweet Surprise;" was farrowed March 14th, 1880; bred by Mr. Richard Speight, Bradford; sire, "Hero;" dam, "Sunshine," by "Peter."

Middle White Breed—Breeding Sow Pigs, of the same Litter, farrowed in the Year 1882*—Pens of Three.*

THE EARL OF ELLESMERE, Worsley Hall, FIRST PRIZE, 10*l.*: were farrowed Jan. 10th; bred by himself; sire, "Lord Lyon;" dam by "King Duncan."

JOHN and JOSEPH NUTTALL, 13, Longfield, Heywood, Lancashire: SECOND PRIZE, 5*l.*; were farrowed Jan. 12th; bred by themselves; sire, "Hero;" dam, "Lucy," by "Tichborne."

F. A. WALKER-JONES, Mollington, Chester: the *Reserve Number*; were farrowed Jan. 7th; bred by himself; sire, "Star;" dam, "Comedy."

Middle White Breed—Breeding Sows farrowed previously to or in the Year 1881.

The Earl of Ellesmere, Worsley Hall: First Prize, 10*l.*, for "Princess;" was farrowed Aug. 7th, 1880; bred by himself; sire, "Peter;" dam, "Lady Howard."

Wilson, Crosby and Co., Apperley Bridge, Leeds: Second Prize, 5*l.*, for "Airedale Duchess 2nd;" was farrowed May 28th, 1878; bred by Mr. Stephen Blakey, Otley, Yorkshire; sire, "Peter;" dam, "Footstep," by "Ocean King."

F. A. Walker-Jones, Mollington, Chester: the *Reserve Number* to "Duchess 2nd;" was farrowed Oct. 26th, 1878; bred by Mr. A. Crowther, Star Brewery, Bury, Lancashire; sire, "Albert;" dam, "Duchess 1st," by "Bill 1st."

Small White Breed—Boars farrowed in the Year 1881.

Wilson, Crosby and Co., Apperley Bridge, Leeds: First Prize, 10*l.*, for "Prince Leopold;" was farrowed May 21st; bred by Mr. Saunders Spencer, Holywell Manor, St. Ives, Hunts; sire, "Omega;" dam, "Shortnose," by "Pat."

The Earl of Radnor, Coleshill House, Highworth, Wilts: Second Prize, 5*l.*; was farrowed Sept. 20th; bred by himself; sire, "Shah;" dam, "Princess."

Lord Moreton, M.P., Tortworth Court, Falfield, R.S.O., Gloucestershire: the *Reserve Number*; was farrowed July 18th; bred by himself; sire, "Convict;" dam, "Spot 2nd," by "Barrister."

Small White Breed—Boars farrowed in the Year 1879 *or* 1880.

Lord Moreton, M.P., Tortworth Court: First Prize, 10*l.*; was farrowed May 3rd, 1880; bred by himself; sire, "Purity;" dam, "Little Worcester," by "Triumph;" and Second Prize, 5*l.*; was farrowed July 12th, 1880; bred by himself; sire, "Purity;" dam, "Spot 2nd," by "Barrister."

Captain Philip Green, Bayham Abbey, Lamberhurst, Sussex: the *Reserve Number* and *Highly Commended* for "Denmark;" was farrowed Sept. 22nd, 1880; bred by himself.

Small White Breed—Breeding Sow Pigs, of the same Litter, farrowed in the Year 1882—*Pens of Three.*

The Earl of Ellesmere, Worsley Hall: First Prize, 10*l.*; were farrowed Jan. 13th; bred by himself; sire, "The Swell;" dam by "Marquis."

Charles Elmhirst Duckering, Northorpe, Kirton-Lindsey, Lincolnshire: Second Prize, 5*l.*; were farrowed Jan. 24; bred by himself.

The Earl of Radnor, Coleshill House, Highworth: the *Reserve Number* and *Highly Commended;* were farrowed Jan. 4th; bred by himself; sire, "Sir Garnet;" dam, "Darlington."

Small White Breed—Breeding Sows farrowed previously to or in the Year 1881.

The Earl of Ellesmere, Worsley Hall, Manchester: First Prize, 10*l.*, for "Spot;" was farrowed June 14th, 1880; bred by Mr. P. Ashcroft, Rufford, Lancashire.

F. A. Walker-Jones, Mollington, Chester: Second Prize, 5*l.*; was farrowed September 12th, 1879; bred by himself; sire, "Roger;" dam, "Loo."

Charles Elmhirst Duckering, Northorpe, Kirton-Lindsey, Lincolnshire: the *Reserve Number* and *Highly Commended*; was farrowed January 27th, 1880; bred by himself.

Small Black Breed—Boars farrowed in the Year 1881.

Joseph Alfred Smith, Rise Hall, Akenham, Ipswich, Suffolk: First Prize, 10*l.*, for "Jumbo;" was farrowed in January; bred by himself; sire, "Blair Athol 2nd;" dam, "Hope."

William Stenlake Northey, Tinhay, Lifton, Devon; Second Prize, 5*l.*, for "Conjuror;" was farrowed July 1st; bred by himself; dam, "Beauty," by "Camballo."

Joseph Alfred Smith, Rise Hall: the *Reserve Number* and *Highly Commended* for "Prince;" was farrowed in July; bred by himself; sire, "Parnell;" dam, "Hope," by "Cetewayo."

Small Black Breed—Boars farrowed in the Year 1879 *or* 1880.

Henry Charles Bliss Gilbert, Braydestone Hall, Blofield, Norfolk: First Prize, 10*l.*, for "Sir Charles;" was farrowed July 2nd, 1880; bred by Major William Dods, Gorlestone, Norfolk; sire, "Camballo;" dam, "May," by "Top Sawyer."

William Wheeler, Long Compton, Shipston-on-Stour, Warwickshire: Second Prize, 5*l.*, for "Royal Winner;" was farrowed June 8th, 1880; bred by himself.

Charles Elmhirst Duckering, Northorpe, Kirton-Lindsey, Lincolnshire: the *Reserve Number* and *Commended*; was farrowed January 10th, 1880; bred by himself.

Small Black Breed—Breeding Sow Pigs of the same litter, farrowed in the Year 1882.—*Pens of Three.*

Henry Charles Bliss Gilbert, Braydestone Hall, Blofield, Norfolk: First Prize, 10*l.*, for "Shotover," "St. Marguerite," "Lizzie;" were farrowed January 4th; bred by himself; sire, "Own Brother to Robert the Devil;" dam, "Miss Short Tail," by "Excelsior."

The Duke of Hamilton and Brandon, K.T., Easton Park, Wickham Market: Second Prize, 5*l.*; were farrowed January 6th; bred by himself; sire, "Sam;" dam, "Diamond."

William Wheeler, Long Compton, Shipston-on-Stour: the *Reserve Number* for "Beat us if you can;" were farrowed July 2nd; bred by himself; sire, "Royal Winner."

Breeding Sows farrowed previously to or in the Year 1881.

Rev. William Hooper, Chilfrome Rectory, Dorchester: First Prize, 10*l.*, for "Alice;" was farrowed January 10th, 1881; in-pig; bred by himself.

The Earl of Portsmouth, Eggesford House, Wembworthy, Devon: Second Prize, 5*l.*, for "Lady Kirton;" was farrowed July 24th, 1880; in-pig; bred by himself; sire, "Camballo;" dam by "Duke of Camborne."

WILSON, CROSBY, AND CO., Apperley Bridge, Leeds: the *Reserve Number* and *Highly Commended* for "Topsy;" was farrowed January 20th, 1881; breeder unknown.

Berkshire Boars farrowed in the Year 1881.

WILLIAM HEWER, Sevenhampton, Highworth: FIRST PRIZE, 10*l.*; was farrowed September 2nd; bred by himself; sire, "Artful Joe;" dam, "Frolic," by "Wrangler."

THE EXECUTORS OF THE LATE ARTHUR STEWART, Saint Bridge Farm, Gloucester: SECOND PRIZE, 5*l.*; was farrowed July 13th; bred by themselves; sire, "Exor;" dam, "Black Girl," by "Spiteful 2nd."

RUSSELL SWANWICK, Royal Agricultural College Farm, Cirencester: the *Reserve Number* and *Highly Commended*; was farrowed June 3rd; bred by himself; sire, "Gloucester IV.;" dam, "Sister of Sally CX.," by "Hopeful I."

Berkshire Boars farrowed in the Year 1879 *or* 1880.

HEBER HUMFREY, Kingstone Farm, Shrivenham, Berks: FIRST PRIZE, 10*l.*, for "Leinster;" was farrowed June 7th, 1880; bred by himself; sire, "Connaught;" dam, "Donna Therese," by "Little Western."

R. P. HUMPHERY, Valetta, Watcombe, Torquay, Devon: SECOND PRIZE, 5*l.*, for "Lord of the Harem;" was farrowed June 1st, 1880; bred by himself; sire, "Stanley;" dam, "Lady Leycester," by "Toddington."

BENJAMIN ST. JOHN ACKERS, Prinknash Park, Painswick, Gloucestershire: the *Reserve Number* and *Highly Commended* for "Kingfisher;" was farrowed July 7th, 1879; bred by himself; sire, "Hesperian Major;" dam, "Fair Flora 6th," by "Hesperian Major."

Berkshire Breeding Sow Pigs of the same litter, farrowed in the Year 1882.—*Pens of Three.*

WILLIAM HEWER, Sevenhampton, Highworth, Wiltshire: FIRST PRIZE, 10*l.*; were farrowed January 8th; bred by Mr. T. S. Hewer, Knighton Farm, Ramsbury, Wilts; sire, "Knighton Lad;" dam, "Hagar," by "Hopewell 2nd."

THOMAS PRICE WILLIS, The Elms, Winslow, Bucks: SECOND PRIZE, 5*l.*: were farrowed January 7th; bred by himself; sire, "Champion;" dam, "Topsy."

MAJOR PEPLOE, Garnstone Castle, Weobley, Herefordshire: the *Reserve Number* and *Highly Commended*; were farrowed January 7th; bred by himself; sire, "Leinster Don;" dam, "Bobtail," by "Soporific."

Berkshire Breeding Sows farrowed previously to or in the Year 1881.

THE EXECUTORS OF THE LATE ARTHUR STEWART, Saint Bridge Farm, Gloucester: FIRST PRIZE, 10*l.*; was farrowed February 17th, 1881; in-pig: bred by themselves; sire, "Exor;" dam, "Cirencester 2nd," by "Prodigal."

JOHN PITTMAN KING, North Stoke, Wallingford, Berks: SECOND PRIZE, 5*l.*, for "Ruby 4th;" was farrowed December 10th, 1880; in-pig; bred by himself; sire, "Samphire;" dam, "Ruby 3rd."

NATHANIEL BENJAFIELD, Shorts Green Farm, Motcombe, Shaftesbury: the *Reserve Number* and *Highly Commended* for "Lady Tredegar;" was farrowed June 2nd, 1879; in-pig; bred by himself; sire, "Rubstone;" dam, "Taunton Duchess 2nd," by "Robin Hood 2nd."

CHEESE.

*Cheese, not less than 1 cwt., over 6 inches thick, open to makers only.**

JOHN WILLIS, Witchem Farm, Cattistock, Dorchester: FIRST PRIZE, 10*l*.

WILLIAM CORP, Sandford Orcas, Sherborne, Dorset: SECOND PRIZE, 5*l*.

JOHN CHARLES CREES, Sharpshaw Farm, Marston Biggott, Frome: the *Reserve Number* and *Highly Commended.*

*Cheese, not less than 1 cwt., not exceeding 6 inches thick, open to makers only.**

ALFRED HISCOCK, Parson's Farm, Horsington, Wincanton, Somerset: FIRST PRIZE, 10*l*.

THOMAS JOHN MOON, Vallis Farm, Frome: SECOND PRIZE, 5*l*.

EDWARD JOHN HODDINOTT, Witham Hall Farm, Frome: the *Reserve Number* and *Highly Commended.*

BUTTER.

*Fresh Butter, six pounds, open to makers only.**

WILLIAM BILLINGTON, Church Farm, Yattenden, Newbury: FIRST PRIZE, 6*l*.

GEORGE SIMPSON, Wray Park, Reigate: SECOND PRIZE, 4*l*.

GERARD HORNE FITZHERBERT, Overton House, Micheldever: THIRD PRIZE, 2*l*.

W. J. PALMER, Great Lea Farm, Shinfield, Berks: the *Reserve Number* and *Highly Commended.*

FRUIT.

White Cherries.

JOHN MARTEN, Chilham, Canterbury: FIRST PRIZE, 3*l*.

Black Cherries.

JOHN MARTEN, Chilham, Canterbury: FIRST PRIZE, 3*l*.

White Gooseberries.

SIDNEY HERBERT GOODWIN, Smartswell, Mereworth, Maidstone: FIRST PRIZE, 3*l*.

Red Currants.

THOMAS HARRIS BUSBRIDGE, Jun., Pimps Court, East Farleigh, Maidstone: FIRST PRIZE, 3*l.*

JOHN MARTEN, Chilham, Canterbury: SECOND PRIZE, 1*l.*

Black Currants.

WILLIAM PARROTT, Normandy, Guildford: FIRST PRIZE, 3*l.*

JOHN MARTEN, Chilham, Canterbury: SECOND PRIZE, 1*l.*

Keeping Apples—Cooking.

JOHN WATKINS, Pomona Farm, Withington, Hereford: FIRST PRIZE, 3*l.*

HEBER HUMFREY, Kingstone Farm, Shrivenham, Berks: SECOND PRIZE, 1*l.*

VEGETABLES.

Early Kidney Potatoes.

JAMES DAVIDSON, Heckfield, Winchfield: FIRST PRIZE, 3*l.*

Cauliflowers.

JAMES DAVIDSON: FIRST PRIZE, 3*l.*

Best Collection of Vegetables, open to Market Gardeners.

JOSEPH C. FIDLER, 104, Friar Street, Reading: FIRST PRIZE, 6*l.*

HIVES, HONEY, &c.

PRIZES GIVEN BY THE BRITISH BEE-KEEPERS' ASSOCIATION.

Hives for Observation Purposes, Stocked with Bees and their Queen.

T. B. BLOW, Welwyn, Herts: FIRST PRIZE, 1*l.*; SECOND PRIZE, 15*s.*; and THIRD PRIZE, 10*s.*

Frame Hives for use in an Apiary. Price not to exceed 15*s.*

A. BLAKE, Dallinghoo, Wickham Market: FIRST PRIZE, 1*l.*

T. B. BLOW, Welwyn, Herts: SECOND PRIZE, 15*s.*

REV. W. E. BURKITT, Buttermere Rectory, Hungerford; THIRD PRIZE, 10*s.*

Frame Hives for Cottagers' use. Price not to exceed 10*s.* 6*d.*

T. B. BLOW, Welwyn, Herts: FIRST PRIZE, 1*l.*

A. BLAKE, Dallinghoo, Wickham Market: SECOND PRIZE, 15*s.*

ABBOTT, BROTHERS, Fairlawn, Southall: THIRD PRIZE, 10*s.*

Collection of Hives and Bee Furniture.

T. B. Blow, Welwyn, Herts: First Prize, 3*l.*

G. Neighbour and Son, 149, Regent Street, London: Second Prize, 2*l.*

Abbott, Brothers, Fairlawn, Southall: Third Prize, 1*l.*

Super Honey from one Apiary.

J. Walton, Westington, Leamington: Third Prize, 10*s.*

Comb Honey. Twelve 2 lb. Sections.

J. Garratt, Hockendon, St. Mary Cray, Kent: First Prize, 1*l.*

W. Hunt, South Warnborough, Winchfield: Second Pize, 10*s.*

J. Walton, Weston, Leamington: Third Prize, 5*s.*

Comb Honey. Twelve 1 lb. Sections.

J. Garratt: First Prize, 1*l.*

R. W. Lloyd, Badminton, Gloucestershire: Second Prize, 10*s.*

W. Hunt: Third Prize, 5*s.*

Run, or Extracted Honey. Twelve 1 lb. glass jars.

J. Velvin, Marlborough, Wilts: First Prize, 1*l.*

R. W. Lloyd: Second Prize, 10*s.*

Rev. W. E. Burkitt, Buttermere Rectory, Hungerford: Third Prize, 5*s.*

Run, or Extracted Honey. Twelve 2 lb. glass jars.

J. Walton: First Prize, 1*l.*

Comb Foundation of Pure Bees-Wax.

T. B. Blow: First Prize, 1*l.*

Abbott, Brothers: Second Prize, 10*s.*

Pure Bees-Wax, not less than 6 lbs.

Abbott, Brothers: First Prize, 10*s.*

W. Hunt: Second Prize, 5*s.*

FARMS.

*Dairy, Arable, or Mixed Farms, above 200 acres in extent.**

James J. Ratcliff, The Priory, Beech Hill, Reading: First Prize, 100*l.*

George Adams, Pidnell Farm, Faringdon: Second Prize, 50*l.*

Jenkin Davies, Wickcroft Farm, Englefield, Reading: Special Prize, 25*l.*

IMPLEMENTS.

D. Hald and Co., 24, Great Winchester Street, London: Gold Medal for Cream Separator for horse power.

The Reading Iron Works Co.: Silver Medal for Machine for Washing Railway Milk Cans.

Nalder and Nalder, Challow Works, Wantage: Silver Medal for an improved method of driving shakers and riddles in threshing machines.

George Hathaway, Chippenham, Wilts: Silver Medal for Double Oscillating Churn.

The Prize of 10*l.* offered by Martin J. Sutton, Esq., of Reading, for the most efficient and economical method of drying hay or corn crops artificially, either before or after being stacked, was not awarded.

AGRICULTURAL EDUCATION.

Examination Papers, 1882.

EXAMINATION IN AGRICULTURE.

MAXIMUM NUMBER OF MARKS, 200. PASS NUMBER, 100.

Tuesday, May 9th, from 10 *a.m. till* 1 *p.m.*

1. What would be the required live and dead stock for a farm of 600 acres; 400 acres of which should be arable land of good quality, capable of growing roots and beans, the other 200 acres good grazing pasture land?

The same where the arable land should be medium clay soil and the pasture land of fair quality suitable for dairying?

The same where the arable land should be a stone brash and the pasture of a rough healthy quality, suitable for the rearing of stock?

2. State the best rotation of cropping for the arable land on each of the above-mentioned description of soil.

3. If, on entering a light-land farm at any Michaelmas, you found the part in course for roots to be full of couch and other weeds, what would be your cultivation for such roots with a view to cleaning the land before planting it?

4. State the quantity of seed-wheat which should be planted per acre on different kinds of soils, and under the different conditions of such soils.

5. The same of Barley.

6. A quantity of wheat has to be thrashed. How many men would be required for the work, the straw being stacked in the yard, and a 6-horse engine with a finishing machine being used?

7. Given, a field of wheat-stooks (a good crop) to be carted half-a-mile to the homestead, two pitchers being employed for the work. How many horses and carts, or waggons would be required, and how many men at the rick?

8. Describe the proper management of breeding Ewes, from October to the time they are brought to fold, and of lambs from birth until they are weaned.

9. What quantity of corn or cake is it desirable to give to feeding sheep on turnips when but little hay can be spared for them in their chaff? Secondly, when they have all hay-chaff of good quality?

10. Describe the proper management of young stock on a farm suitable for rearing cattle from the time they are brought in as calves until they are two years old.

11. When is it desirable to give milking cows artificial food?

12. How many horses per 100 acres are required to work a farm of arable land, the soil being light?

The same, the soil being heavy?

EXAMINATION IN CHEMISTRY.

Maximum Number of Marks, 200. Pass Number, 100.

Wednesday, May 10th, from 10 *a.m. till* 1 *p.m.*

I. General Chemistry.

1. Define an element in chemistry, Name some elements which are found in nature uncombined, and others which are only met with in combination. What are the characters of ozone, and what are the reasons for considering it an elementary substance?

2. State the composition of atmospheric air; and explain how to find the proportions of (1), aqueous vapour, (2) carbonic acid, present in it at any given time and place.

3. Show by examples by what means uncombined nitrogen can be brought into combination with other elements. How can you determine whether an organic substance contains nitrogen?

4. State and explain the chemical action which results from exposure to the atmosphere of (1) iron, (2) copper, (3) lime. By what tests can you detect the presence of those three srbstances in solution?

5. Explain generally the chemical action which ensues when wood is heated in a vessel which has only a small opening. Give an account of the properties of charcoal.

6. Define equivalent weights in chemistry, and illustrate your definition by comparing compounds of chlorine with those of iodine, and compounds of iron with those of aluminium and magnesium.

7. Show how to determine the proportions of sodium chloride and sodium nitrate in a mixture of the two.

8. Explain the chemistry of the conversion of alcohol into acetic acid, and the conditions under which this change may be brought about.

9. Describe the general chemical characters of tannin, and give some explanation of its antiseptic power.

II. Agricultural Chemistry.

Wednesday, May 10th, from 2 p.m. till 5 p.m.

1. Point out the differences in the chemical composition of fresh and rotten dung. Describe the best way of making and applying dung to the land with a view of preventing loss in fertilising matters.

2. What is the chemical character of the drainings of dung-heaps, and their fertilising value?

3. What are the chemical compounds which occur in the drainage-water from highly-manured land?

4. Write a short paper on the improvement of grass-land.

5. What is the composition of soot? How do you determine the agricultural and commercial value of different samples?

6. In what respect does gas-lime differ from ordinary lime? Point out the precautions which should be observed in applying gas-lime to the land?

7. Explain the benefits which result from the growth of clover as a preparatory crop for wheat. How do you account for the better yield of wheat after clover which has been made into hay or allowed to seed, than after green clover fed off on the land by sheep?

8. How do you detect the presence of arsenic in a poisonous sheep-dip?

9. Write a short paper on the foods which are best adapted to produce rich and abundant milk in the most economical manner.

EXAMINATION IN MECHANICS AND NATURAL PHILOSOPHY.

Maximum Number of Marks, 200. Pass Number, 100.

Thursday, May 11th, from 10 a.m. till 1 p.m.

1. How are mass and density measured?

If a cubic foot of iron weighs $479\frac{3}{4}$ lbs., and a cubic inch of water 252·5 grains, compare the masses of these bodies, and their densities.

2. Any number of forces act in one plane on a body capable of turning freely round a fine axis at right angles to that plane; what relation must exist between the forces if they keep the body at rest?

To draw a nail out of a packing-case in the usual way, I get the head of the nail between the claws of a hammer whose head rests on the case, touching it at a distance of $1\frac{3}{4}$ inch from the nail; if the handle is 14 inches long, and I pull at the end of it with a force of

30 lbs., what force is exerted on the nail? Why would the force on the nail become less as it rises out of the wood?

3. What is the centre of gravity of a body, and what is its characteristic property? Where is the centre of gravity of a square lamina, of a circular lamina, and of a triangular lamina?

Draw a square ABCD, and on AB draw an equilateral triangle ABP, the point P falling within the square; if ABCD is a rigid lamina weighing 20 lbs. and resting horizontally on three points under A, B, P respectively; find the pressure on each point.

4. What is meant by the work of a force? What is a foot-pound of work?

A rectangular block weighing 27,000 lbs. is 2 yards high, and its base is a square the length of an edge of which is a yard. If it stands on its square base how many foot-pounds of work are required to overthrow it? If it lies on one of its long faces how many foot-pounds of work are required to make it stand up on its base? N.B.—*i.e.*, the square root of 6 = 2·23607.

5. What is the numerical measure of the kinetic energy of, or work accumulated in, a moving particle?

The mass of a particle moving at the rate of 24 feet a second is 10 lbs.; how many foot-pounds of work is it capable of doing in virtue of its kinetic energy? Find the constant force by which the particle would be brought to rest after moving through 8 feet.

6. Explain the principle of the hydraulic press. What practical difficulty long stood in the way of its application? Explain the contrivance by which the difficulty was overcome and a working hydraulic press constructed.

7. Explain the action of the common force pump, and the use of the air-chamber with which force-pumps are sometimes fitted.

8. If a lump of ice is taken at 0° F. and heat is applied to it, what are the successive changes it undergoes, (*a*) in volume, (*b*) in temperature, until it is all boiled away? It is supposed to be in free contact with the air throughout the whole process.

9. A piston 1200 square inches in area is moved forward by a varying pressure through a distance of 6 feet; the pressure in pounds per square inch at each foot of the stroke is 18, 18, 18, 12, 9, 7, 6; calculate the foot-pounds of work done by the pressure in one stroke, and draw the indicator-diagram corresponding to these forces. (The vacuum pressure is to be neglected.)

EXAMINATION IN MENSURATION AND SURVEYING.

MAXIMUM NUMBER OF MARKS, 100. PASS NUMBER, 50.

Thursday, May 11th, from 2 p.m. till 5 p.m.

1. State the rules for finding the area of a triangle in terms of its sides, the area of a circle, and the volume of a cylinder.

The sides of a triangle are 110 feet, 130 feet, and 160 feet

respectively: find its area; find also the area of a circle whose circumference equals the perimeter of the triangle.

2. What is a prismoid? What is the rule, or formula, for finding its volume?

The base of a hay-stack is a rectangle 30 feet by 20 feet; at a height of 15 feet above the base its horizontal section is 35 feet by 25 feet; above this the hay is formed into a gable $12\frac{1}{2}$ feet high—the length and breadth of the gable being, of course, 35 feet and 25 feet. How many cubic yards of hay are there in the stack?

3. Explain how a knowledge of the specific gravity of a substance enables us to determine the weight of a given volume of the substance.

Ten feet of length of lead pipe weigh 100 lbs. when the bore is $2\frac{1}{2}$ inches in diameter; what is the thickness of the metal? Specific gravity of lead is 11·35.

4. State and explain a method of finding the distance between two points on opposite banks of a river, using only ropes and picquets. What are the sources of error in the method?

5. Explain the principle of the Vernier. How is the principle applied in the following case:—to construct a vernier by which readings can be taken true to a minute from the horizontal plate of a Theodolite which is graduated to half degrees?

6. If the diameter of a graduated circle is 5 inches, and the arc can be read true to minutes, into how many parts must each inch of the arc be divided?

7. AB is a base 1250 feet long; P a station such that PAB is 37° 10′, PBA 73° 42′; C is a station which as seen from B is between A and P; the angle ABC is 23° 18′; find, both by construction and calculation, the length of AP and of the parts into which it is divided by the line joining B and C.

8. A map is drawn to the scale of half an inch to a furlong; what is the representative fraction of the scale, and what area on the ground is represented by seven square inches on the map?

9. Draw a section of the ground from the following notes, and calculate in degrees, minutes, and seconds, the slope of the straight line which joins the first point with the last.

Distance.	Back S.		Fore S.	
chains.	ft.	in.	ft.	in.
2·83	7	4	2	1
3·01	1	8	8	7
2·47	2	5	6	8
2·25	1	5	7	4
1·44	6	1	4	2

EXAMINATION IN BOOK-KEEPING.

MAXIMUM NUMBER OF MARKS, 200. PASS NUMBER, 100.

Friday, May 12th, from 10 a.m. till 1 p.m.

Journalise and post the following facts in proper technical language and form. Make out a "Trial Balance Sheet," a "Profit and Loss Account," and a "Final Balance-sheet," showing the position of Edwin Woods' affairs on May 1st, 1881.

Statement of Affairs of Edwin Woods, January 1st, 1881:—

	£	s.	d.
He had assets—			
Wheat in sacks	854	0	0
Barley do.	417	0	0
Straw, estimated at	116	0	0
Tillages do.	175	0	0
Sheep	620	0	0
Horses	100	0	0
Implements and Dead Stock	250	0	0
Cash in till	11	15	8
	£2543	15	8
He owed—			
John Woods, loan	500	0	0
London and County Bank overdrawn	733	6	8
William Markham for sheep	315	0	0
	1548	6	8
Leaving surplus	995	9	0
	£2543	15	8

1881.		£	s.	d.
Jan.	5.—He sold sheep to William Parker for .. .. (receiving cash for same.)	463	0	0
„	8.—He paid William Markham	315	0	0
„	„ He paid to Bank	80	0	0
„	31.—This month expended for Wages from till ..	57	5	0
Feb.	28.—This month drew from Bank for Petty Cash	50	0	0
„	„ This month expended for Wages	68	3	3
Mar.	4.—Sold 60 quarters Wheat at 36*s.* to John Smiles for cash	108	0	0
„	6.—Bought 11 Heifers of Jagger for	82	10	0
„	10.—Sold Straw to Squire Oakes for	40	14	6
„	11.—Drew Bill on Squire Oakes for the above (due 14th May)	40	14	6
„	14.—Remitted Jagger Squire Oakes' bill 40*l.* 14*s.* 6*d.* and cheque on Bank 41*l.* 15*s.* 6*d.* to balance his account			

1881.		£	s.	d.
Mar. 31.—	Paid for Wages, &c., this month	78	19	6
„ „	Paid Rent by cheque on Bank	75	0	0
April 6.—	Sold to John Simes, Wheat	627	0	0
„ „	Sold to Thomas Davis, Barley	463	0	5
„ 14.—	Paid by cheque for Rates	18	19	0
„ „	Received of John Simes—			
	Cash (sent to Bank)	380	0	0
	Bill at three months	247	0	0
„ 20.—	Sent the above bills to the Bank for discount, they amount to	710	0	0
„ „	The Bank charged discount	9	14	7
„ „	Received of Thomas Davis bill at three months	463	0	0
„ 21.—	Sold Wheat for cash	187	10	0
„ „	Sold Straw for cash	69	0	0
„ 23.—	Sent cash to Bank	180	0	0
„ 30.—	Paid Wages, &c., this month	83	19	5
„ „	Bought Sheep of Wilson	274	0	0
„ „	Jackson's bill sent in for Fodder supplied ..	87	0	0
„ „	Fisher's bill sent in for Manure	38	0	0
„ „	Paid John Woods interest three months to 31st March	7	10	0
„ „	Reserve for one month's interest to date due to John Woods	2	10	0
	The position of affairs on 1st May having been ascertained by a Stock-taking, it appeared that there was no Wheat.			
	Barley .. .. valued	15	0	0
	Straw .. .. „	8	0	0
	Sheep .. .. „	470	0	0
	Heifers .. .. „	85	0	0
	Tillages .. .. „	250	0	0
	Horses .. .. „	95	0	0
	Implements, &c. .. .. „	246	0	0

EXAMINATION IN GEOLOGY.

MAXIMUM NUMBER OF MARKS, 100. PASS NUMBER, 50.

Friday, May 12th, from 2 p.m. till 5 p.m.

1. Give the classification usually adopted for dividing the stratified rocks into great periods, and state the reasons for the names assigned to them. Tabulate in descending order the systems of strata belonging to each great period.

2. Describe the chief lithological characters of the aqueous rocks, and explain their respective origin.

3. State the geological position and principal agricultural characters of the chief clay formations of England.

4. Define permeable and impermeable strata, and explain how their relative position may influence the origin of springs or the artificial supply of water. Illustrate the answer by diagrams if necessary.

5. Describe the nature and position of the Crag deposits.

6. From what strata are septaria and clay-ironstone usually obtained? Explain their origin and the purposes to which they are applied.

7. Tabulate in descending order the carboniferous series of rocks. Mention the building stones and other economical substances obtained from them.

8. Explain the nature of the fossil plants generally found in the carboniferous rocks.

9. Describe the character and origin of the Wealden strata.

10. By what natural processes have the stratified rocks been hardened or consolidated, and state the value of this knowledge in the selection of building stones.

11. In what British strata are phosphatic deposits mostly found? How has their origin been explained?

12. Name the specimens on the table.

EXAMINATION IN BOTANY.

[It is expected that Eight Questions at least will be answered.]

MAXIMUM NUMBER OF MARKS, 100. PASS NUMBER, 50.

Saturday, May 13*th, from* 10 *a.m. till* 1 *p.m.*

1. What are the contents of an active leaf-cell, and what are their respective functions?

2. What are the elements of a dicotyledonous stem from the pith to the bark?

3. Give descriptions and examples of a bulb, corm, tuber, and rhizome.

4. What physical conditions are necessary for the germination of a seed?

5. What are the differences between fertilisation in angiosperms, gymnosperms, ferns, and mosses?

6. What are the elementary constituents of the food of plants?

7. How is food assimilated by the plant? Specify the organs by which food is assimilated, and the conditions under which the process takes place.

8. Specify the principal groups into which the cryptogamia are arranged; give their distinguishing characters, and an example of each.

9. Give the characters by which the *Ranunculaceæ Cruciferæ*, and *Gramineæ* are distinguished.

10. Describe the life history of Ergot, and state what may be expected from its presence in pasture.

11. Give the scientific names and Natural Orders of the following plants:—cow-grass, buck-wheat, oats, rib-grass, beet, and rape.

12. Give scientific descriptions of the plants marked A, B, and C.

EXAMINATION IN ANATOMY AND ANIMAL PHYSIOLOGY.

MAXIMUM NUMBER OF MARKS, 100. PASS NUMBER, 50.

Saturday, May 13th, from 2 p.m. till 4 p.m.

1. Say in which animal, the horse, ox, or sheep, the respiration is carried on through the nostrils exclusively, and state the cause of this variation from the general rule.

2. Name the fluids which are chiefly employed in the process of assimilation, and state their relative action—vital and chemical—on the ingesta.

3. Supposing the tongue of a horse and an ox to be placed before you, state how you would recognise the one from the other; describe also in general terms the anatomy of the organ.

4. Describe the function of the tongue, pharynx, and œsophagus in deglutition and rumination, and say which of the stomachs of the ox is chiefly employed in rumination, and what is the function of each of the other stomachs.

5. Describe the dentition of a year-old and a two-year-old ox, stating the relative number, in each case, of incisor and molar teeth—permanent and temporary.

6. Name the structures which enter into the composition of a tooth, and describe fully the dentition of a pig at six, nine, and twelve months of its age.

MEMORANDA.

ADDRESS OF LETTERS.—The Society's office being situated in the postal district designated by the letter W, Members, in their correspondence with the Secretary, are requested to subjoin that letter to the usual address.

GENERAL MEETING in London, December, 1882, at 12 o'clock.

GENERAL MEETING in London, May 22nd, 1883, at 12 o'clock.

MEETING at York, July, 1883.

MONTHLY COUNCIL (for transaction of business), at 12 o'clock on the first Wednesday in every month, excepting January, September, and October: open only to Members of Council and Governors of the Society.

ADJOURNMENTS.—The Council adjourn over Passion and Easter weeks, when those weeks do not include the first Wednesday of the month; from the first Wednesday in August to the first Wednesday in November; and from the first Wednesday in December to the first Wednesday in February.

OFFICE HOURS.—10 to 4. On Saturdays, 10 to 2.

DISEASES of Cattle, Sheep, and Pigs.—Members have the privilege of applying to the Veterinary Committee of the Society, and of sending animals to the Royal Veterinary College, Camden Town, N.W.—(A statement of these privileges will be found on page lxxxix. in this Appendix.)

CHEMICAL ANALYSIS.—The privileges of Chemical Analysis enjoyed by Members of the Society will be found stated in this Appendix (page xc.).

BOTANICAL PRIVILEGES.—The Botanical and Entomological Privileges enjoyed by Members of the Society will be found stated in this Appendix (page xciii.).

SUBSCRIPTIONS.—1. Annual.—The subscription of a Governor is £5, and that of a Member £1, due in advance on the 1st of January of each year, and becoming in arrear if unpaid by the 1st of June. 2. For Life.—Governors may compound for their subscription for future years by paying at once the sum of £50, and Members by paying £10. Governors and Members who have paid their annual subscription for 20 years or upwards, and whose subscriptions are not in arrear, may compound for future annual subscriptions, that of the current year inclusive, by a single payment of £25 for a Governor, and £5 for a Member.

PAYMENTS.—Subscriptions may be paid to the Secretary, in the most direct and satisfactory manner, either at the Office of the Society, No. 12, Hanover Square, London, W., or by means of post-office orders, to be obtained at any of the principal post-offices throughout the kingdom, and made payable to him at the Vere Street Office, London, W.; but any cheque on a banker's or any other house of business in London will be equally available, if made payable on demand. In obtaining post-office orders care should be taken to give the postmaster the correct initials and surname of the Secretary of the Society (H. M. Jenkins), otherwise the payment will be refused to him at the post-office on which such order has been obtained; and when remitting the money-orders it should be stated by whom, and on whose account, they are sent. Cheques should be made payable as drafts on demand (not as bills only payable after sight or a certain number of days after date), and should be drawn on a London (not on a local country) banker. When payment is made to the London and Westminster Bank, St. James's Square Branch, as the bankers of the Society, it will be desirable that the Secretary should be advised by letter of such payment, in order that the entry in the banker's book may be at once identified, and the amount posted to the credit of the proper party. No coin can be remitted by post, unless the letter be registered.

NEW MEMBERS.—Every candidate for admission into the Society must be proposed by a Member; the proposer to specify in writing the full name, usual place of residence, and post-town, of the candidate, either at a Council meeting, or by letter addressed to the Secretary. Forms of Proposal may be obtained on application to the Secretary.

*** Members may obtain on application to the Secretary copies of an Abstract of the Charter and Bye-laws, of a Statement of the General Objects, &c., of the Society, of Chemical, Botanical, and Veterinary Privileges, and of other printed papers connected with special departments of the Society's business.

Members' Veterinary Privileges.

I.—Visits of a Professor of the Royal Veterinary College.

1. Any Member of the Society who may desire professional attendance and special advice in cases of disease among his cattle, sheep, or pigs, should apply to the Secretary of the Society, or to the Principal of the Royal Veterinary College, Camden Town, London, N.W.

2. The remuneration of the Veterinary Surgeon or a visiting Inspector will be 2*l.* 2*s.* each day as a professional fee, and the charge for personal expenses, *when such have been incurred*, which will in no case exceed one guinea per diem. He will also be allowed to charge the cost of travelling to and from the locality where his services may have been required. These charges may, however, in cases of serious or extensive outbreaks of contagious disease, be reduced or remitted altogether, so far as the Members of the Society are concerned, at the discretion of the Council, on such step being recommended to them by the Veterinary Committee.

3. The Consulting Veterinary Surgeon or visiting Inspector, on his return, will report to the Member, and, through the Principal of the Royal Veterinary College, to the Veterinary Committee, in writing, the results of his observations and proceedings with reference to the disease; which Report will be laid before the Council.

4. When contingencies arise to prevent a personal discharge of the duties, the Principal of the Royal Veterinary College may, subject to the approval of the Veterinary Committee, name some competent professional person to act in his stead, who shall be remunerated at the same rate.

II.—Consultations without Visit.

Personal consultation with Veterinary Inspector	10*s.* 6*d.*
Consultation by letter	10*s.* 6*d.*
Post-mortem examination, and report thereon	21*s.*

A return of the number of applications from Members of the Society during each half-year is required from the Consulting Veterinary Surgeon.

III.—Admission of Diseased Animals to the Royal Veterinary College, Camden Town, N.W.; Investigations and Reports.

1. All Members of the Society have the privilege of sending cattle, sheep, and pigs to the Infirmary of the Royal Veterinary College, on the following terms, viz. by paying for the keep and treatment of cattle 10*s.* 6*d.* per week each animal, and for sheep and pigs, 3*s.* 6*d.* per week.

2. A detailed Report of the cases of cattle, sheep, and pigs treated in the Infirmary of the College, or on Farms in the occupation of Members of the Society, will be furnished to the Council quarterly; and also special reports from time to time on any matter of unusual interest which may come under the notice of the Officers of the College.

IV.—Visits of Provincial Veterinary Surgeons.

The following Veterinary Surgeons have been appointed, at different centres in England and Wales, for the purpose of enabling Members of the Society to consult them with regard to the diseases of cattle, sheep, and pigs.

Mr. C. Stephenson, Sandyford Villa, Newcastle-on-Tyne.
Mr. Joseph Carter, 38, Great Horton Road, Bradford.
Mr. Walter Lewis, 1, South Street, Nantwich Road, Crewe.
Mr. D. Gresswell, Louth.
Mr. W. F. Garside, Royal Agricultural College, Cirencester.
Mr. T. J. Merrick, Northampton.
Mr. G. A. Banham, Downing Street, Cambridge.
Mr. Charles Moir, Cardiff.
Mr. Wm. Penhale, Barnstaple.
Mr. Thomas D. Broad, Broad Street, Bath.
Mr. Wm. Bromley, Lancaster.
Mr. Osborn Hills, 1, 3, 5, and 7, South Parade, Leamington.

Members may obtain the attendance of a Provincial Veterinary Surgeon in any case of disease by paying his travelling expenses (which include railway fares, and 1*s.* per mile if by road, including the return journey), and the cost of his visit, which will be at the following rate, viz.:—

	£	*s.*	*d.*
When the whole day is occupied	1	10	0
When half a day or less is occupied	0	15	0
Personal consultation with Veterinary Surgeon	0	10	0
Consultation by letter	0	5	0
Post-mortem examination and report thereon	1	0	0

A return of the number of applications from Members of the Society during each half year, embodying a statement of those cases which may be of public interest, is required from each Provincial Veterinary Surgeon. These half-yearly reports should reach the Secretary by the end of May and November respectively.

By Order of the Council,

H. M. JENKINS, *Secretary.*

Members' Privileges of Chemical Analysis.

(Applicable only to the case of Persons who are not commercially engaged in the manufacture or sale of any substance sent for Analysis.)

The Council have fixed the following rates of Charges for Analysis to be made by the Consulting Chemist for the *bonâ-fide* and sole use of Members of the Society; who, to avoid all unnecessary correspondence, are particularly requested, when applying to him, to mention the kind of analysis they require, and to quote its number in the subjoined schedule. The charge for analysis, together with the carriage of the specimens (if any), must be paid to him by Members at the time of their application:

No.		
1.	—An opinion of the genuineness of bone-dust or oil-cake (each sample)	2*s*. 6*d*.
2.	—An estimate of the value (relatively to the average samples in the market) of sulphate and muriate of ammonia and of the nitrates of potash and soda	5*s*.
3.	—An analysis of guano; showing the proportion of moisture, organic matter, sand, phosphate of lime, alkaline salts and ammonia, and an estimate of its value, provided the selling price of the article to be analysed be sent with it	10*s*.
4.	—An analysis of mineral superphosphate of lime for soluble phosphates only, and an estimate of its value, provided the selling price of the article to be analysed be sent with it	5*s*.
5.	—An analysis of superphosphate of lime, showing the proportions of moisture, organic matter, sand, soluble and insoluble phosphates, sulphate of lime, and ammonia, and an estimate of its value, provided the selling price of the article to be analysed be sent with it ..	10*s*.
6.	—An analysis, showing the value of bone-dust or any other ordinary artificial manure, provided the selling price of the manure to be analysed be sent with it	10*s*.
7.	—An analysis of limestone, showing the proportion of lime	7*s*. 6*d*.
8.	—An analysis of limestone, showing the proportion of magnesia, 10*s*.; the proportion of lime and magnesia	10*s*.
9.	—An analysis of limestone or marls, showing the proportion of carbonate, phosphate, and sulphate of lime and magnesia, with sand and clay	10*s*.
10.	—Partial analysis of a soil, including determinations of clay, sand, organic matter, and carbonate of lime	10*s*.
11.	—Complete analysis of a soil	£3
12.	—An analysis of oil-cake or other substance used for feeding purposes, showing the proportion of moisture, oil, mineral matter, albuminous matter, and woody fibre, as well as of starch, gum, and sugar in the aggregate; and an opinion of its feeding and fattening or milk-producing properties	10*s*.
13.	—Analysis of any vegetable product	10*s*.
14.	—Analysis of animal products, refuse substances used for manures, &c.	from 10*s*. to £1
15.	—Determination of the "hardness" of a sample of water before and after boiling	5*s*.
16.	—Analysis of water of land-drainage, and of water used for irrigation	£1
17.	—Analysis of water used for domestic purposes	£1 10*s*.
18.	—Determination of nitric acid in a sample of water	10*s*.
19.	—Examination of Viscera for Metallic poison	£2 2*s*.
20.	—Examination of Viscera complete, for metals and alkaloids	£5 5*s*.
21.	—Personal consultation with the Consulting Chemist. (The usual hours of attendance for the Director, Monday excepted, will be from 11 to 2, but to prevent disappointment, it is suggested that Members desiring to hold a consultation with the Director should write to make an appointment)	5*s*.
22.	—Consultation by letter	5*s*.
23.	—Consultation necessitating the writing of three or more letters ..	10*s*.

The Laboratory of the Society is at 12, Hanover Square, London, W., to which address the Consulting Chemist, Dr. Augustus Voelcker, F.R.S., requests that all letters and parcels (postage and carriage paid) from Members of the Society, who are entitled to avail themselves of the foregoing Privileges, should be directed.

GUIDE TO THE PURCHASE OF ARTIFICIAL MANURES AND FEEDING STUFFS.

Feeding Cakes.

1. *Linseed-cake* should be purchased as "Pure," and the insertion of this word on the invoice should be insisted upon. The use of such words as "Best," "Genuine," &c., should be objected to by the purchaser.

2. *Rape-cake for feeding purposes* should be guaranteed "Pure" and purchased by sample.

3. *Decorticated Cotton-cake* should be guaranteed "Pure," and purchased by sample.

4. *Undecorticated Cotton-cake* should be guaranteed "Pure," and purchased by sample.

N.B.—All feeding cakes should be purchased in good condition, and the guarantee of the vendor should be immediately checked by a fair sample (taken out of the middle of the cake) being at once sent for examination to a competent analytical chemist. The remainder of the cake from which the sample sent for examination had been taken should be sealed up in the presence of a witness, and retained by the purchaser for reference in case of dispute.

Artificial Manures.

1. *Raw or Green Bones or Bone-dust* should be purchased as "Pure" Raw Bones guaranteed to contain not less than 45 per cent. of tribasic phosphate of lime, and to yield not less than 4 per cent. of ammonia.

2. *Boiled Bones* should be purchased as "Pure" Boiled Bones guaranteed to contain not less than 48 per cent. of tribasic phosphate of lime, and to yield not less than 1¾ per cent. of ammonia.

3. *Dissolved Bones* are made of various qualities, and are sold at various prices per ton; therefore the quality should be guaranteed, under the heads of *soluble* phosphate of lime, *insoluble* phosphate of lime, and nitrogen or its equivalent as ammonia. The purchaser should also stipulate for an allowance for each unit per cent. which the dissolved bones should be found on analysis to contain less than the guaranteed percentages of the three substances already mentioned.

4. *Mineral Superphosphates* should be guaranteed to be delivered in a sufficiently dry and powdery condition, and to contain a certain percentage of *soluble* phosphate of lime, at a certain price per unit per cent., no value to be attached to *insoluble* phosphates.

5. *Compound Artificial Manures* should be purchased in the same manner and with the same guarantees as Dissolved Bones.

6. *Nitrate of Soda* should be guaranteed by the vendor to contain from 94 to 95 per cent. of pure nitrate.

7. *Sulphate of Ammonia* should be guaranteed by the vendor to contain not less than 23 per cent. of ammonia.

8. *Peruvian Guano* should be sold under that name, and guaranteed to be in a dry and friable condition, and to contain a certain percentage of ammonia.

N.B.—Artificial manures should be guaranteed to be delivered in a sufficiently dry and powdery condition to admit of distribution by the drill. A sample for analysis should be taken, not later than three days after delivery, by emptying several bags, mixing the contents together, and filling two tins holding about half a pound each, in the presence of a witness. Both the tins should be sealed, one kept by the purchaser for reference in case of dispute, and the other forwarded to a competent analytical chemist for examination.

INSTRUCTIONS FOR SELECTING AND SENDING SAMPLES FOR ANALYSIS.

ARTIFICIAL MANURES.—Take a large handful of the manure from three or four bags, mix the whole on a large sheet of paper, breaking down with the hand any lumps present, and fold up in tinfoil, or in oil-silk, about 3 oz. of the well-mixed sample, and send it to 12, HANOVER SQUARE, LONDON, W., by post: or place the mixed manure in a small wooden or tin box, which may be tied by string, but must not be sealed, and send it by post. If the manure be very wet and lumpy, a larger boxful, weighing from 10 to 12 oz., should be sent either by post or railway.

Samples not exceeding 4 oz. in weight may be sent by post, by attaching two penny postage stamps to the parcel.

Samples not exceeding 8 oz., for three postage stamps.

Samples not exceeding 12 oz., for four postage stamps.

The parcels should be addressed: DR. AUGUSTUS VOELCKER, 12, HANOVER SQUARE, LONDON, W., and the address of the sender or the number or mark of the article be stated on parcels.

The samples may be sent in covers, or in boxes, bags of linen or other materials. No parcel sent by post must exceed 12 oz. in weight, 1 foot 6 inches in length, 9 inches in width, and 6 inches in depth.

SOILS.—Have a wooden box made 6 inches long and wide, and from 9 to 12 inches deep, according to the depth of soil and subsoil of the field. Mark out in the field a space of about 12 inches square; dig round in a slanting direction a trench, so as to leave undisturbed a block of soil with its subsoil from 9 to 12 inches deep; trim this block or plan of the field to make it fit into the wooden box, invert the open box over it, press down firmly, then pass a spade under the box and lift it up, gently turn over the box, nail on the lid and send it by goods or parcel to the laboratory. The soil will then be received in the exact position in which it is found in the field.

In the case of very light, sandy, and porous soils, the wooden box may be at once inverted over the soil and forced down by pressure, and then dug out.

WATERS.—Two gallons of water are required for analysis. The water, if possible, should be sent in glass-stoppered Winchester half-gallon bottles, which are readily obtained in any chemist and druggist's shop. If Winchester bottles cannot be procured, the water may be sent in perfectly clean new stoneware spirit-jars surrounded by wickerwork. For the determination of the degree of hardness before and after boiling, only one quart wine-bottle full of water is required.

LIMESTONES, MARLS, IRONSTONES, AND OTHER MINERALS.—Whole pieces, weighing from 3 to 4 oz., should be sent enclosed in small linen bags, or wrapped in paper. Postage 2*d.*, if under 4 oz.

OILCAKES.—Take a sample from the middle of the cake. To this end break a whole cake into two. Then break off a piece from the end where the two halves were joined together, and wrap it in paper, leaving the ends open, and send parcel by post. The piece should weigh from 10 to 12 oz. Postage, 4*d.* If sent by railway, one quarter or half a cake should be forwarded.

FEEDING MEALS.—About 3 oz. will be sufficient for analysis. Enclose the meal in a small linen bag. Send it by post.

On forwarding samples, separate letters should be sent to the laboratory, specifying the nature of the information required, and, if possible, the object in view.

POISONS.—Before a chemical examination is undertaken, a post-mortem should be made by a Veterinary Surgeon, or at the Royal Veterinary College, Camden Town, N.W., and only the necessary Viscera should be sent to the Laboratory for analysis, with a report on the post-mortem.

H. M. JENKINS, *Secretary.*

Members' Botanical and Entomological Privileges.

The Council have fixed the following Rates of Charge for the examination of Plants, Seeds, and Insects for the *bonâ fide* use of Members of the Society, who are particularly requested when applying to the Consulting Botanist, or to the Honorary Consulting Entomologist, to mention the kind of examination they require, and to quote its number in the subjoined Schedule. The charge for examination must be paid at the time of application, and the carriage of all parcels must be prepaid.

I. BOTANICAL.

No.

1.—A report on the purity, amount and nature of foreign materials, perfectness, and germinating power of a sample of seeds .. .. 5*s*.

2.—Detailed report on the weight, purity, perfectness, and germinating power of a sample of seeds, with a special description of the weeds and other foreign materials contained in it .. .. 10*s*.

3.—Determination of the species of any weed or other plant, or of any epiphyte or vegetable parasite, with a report on its habits, and the means of its extermination or prevention .. .. .. 5*s*.

4.—Report on any disease affecting the farm crop .. .. .. 5*s*.

5.—Determination of the species of a collection of natural grasses found in any district of one kind of soil, with a report on their habits and pasture value .. .. 10*s*.

N.B.—*The above Scale of Charges is not applicable in the case of Seedsmen requiring the services of the Consulting Botanist.*

II. ENTOMOLOGICAL.

6.—Determination of the species of any insect, worm, or other animal which, in any stage of its life, injuriously affects the farm crops, with a report on its habits and suggestions as to its extermination 2*s*. 6*d*.

INSTRUCTIONS FOR SELECTING AND SENDING SAMPLES.

In sending seed or corn for examination the utmost care must be taken to secure a fair and honest sample. If anything supposed to be injurious or useless exists in the corn or seed, selected samples should also be sent.

In collecting specimens of plants, the whole plant should be taken up, and the earth shaken from the roots. If possible, the plants must be in flower or fruit. They should be packed in a light box, or in a firm paper parcel.

Specimens of diseased plants or of parasites should be forwarded as fresh as possible. Place them in a bottle, or pack them in tinfoil or oil-silk.

All specimens should be accompanied with a letter specifying the nature of the information required, and stating any local circumstances (soil, situation, &c.) which, in the opinion of the sender, would be likely to throw light on the inquiry.

Parcels or letters containing seeds or plants for examination (Carriage or Postage prepaid) must be addressed to Mr. W. Carruthers, F.R.S., Central House, Central Hill, Norwood, S.E.

Parcels or letters containing insects, or plants apparently infested with insects, sent for examination, must be addressed to Miss Ormerod, Dunster Lodge, Isleworth.

The Council give notice that the following is the standard which is adopted by the Consulting Botanist in his examination of seeds:—

1. That the bulk be true to the species ordered.

2. That it contain not more than five per cent. of seeds other than the species ordered.

3. That the germinating power shall be, for cereals, green crops, clovers, and timothy grass, not less than 90 per cent.; for fox-tail, not less than 20 per cent.; and for other grasses not less than 70 per cent.

The Council recommend that purchasers should require a guarantee in accordance with this standard. They also strongly recommend that the purchase of prepared mixtures should be avoided, and that the different seeds to be sown should be purchased separately.

H. M. JENKINS, *Secretary.*